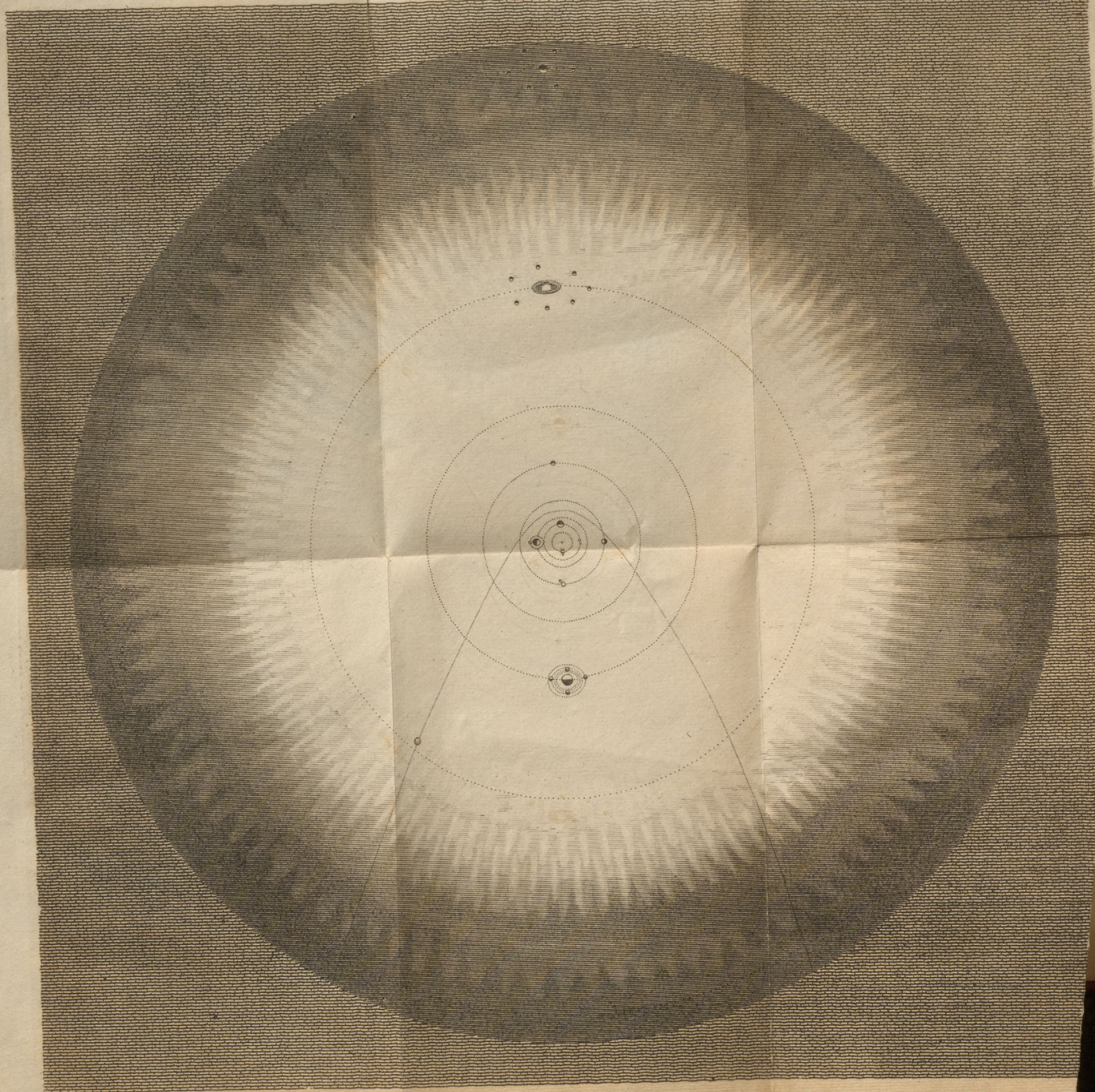
E. W. Holmes

The gift of her

Aunt Theiss.

THE SOLAR SYSTEM.

Plate 1. to Face the Title.



London: William Darton, 58, Holborn Hill, 7th mo. 29th 1823.

THE

WONDERS

OF

THE TELESCOPE;

OR,

A DISPLAY

OF

THE STARRY HEAVENS,

AND OF

THE SYSTEM OF THE UNIVERSE:

CALCULATED TO

PROMOTE AND SIMPLIFY

THE STUDY OF ASTRONOMY.

WITH COPPER-PLATES.

London:

PRINTED (BY ASSIGNMENT) FOR WILLIAM DARTON,
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1823.

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ADVERTISEMENT.

THE success of a small Work, published by the same Editor, under the title of *The Wonders of the Microscope*, has induced him to extend the same plan to the TELESCOPE, an instrument whose powers have not less contributed to the instruction and amusement of mankind.

One of these instruments astonishes us by the wonders it displays relative to the infinite divisibility of matter and the perfection of objects comparatively minute, and the other demonstrates our own insignificance, by affording us a glimpse of infinite space, and of the myriads of worlds and systems of worlds by which it is filled. Both are calculated to excite in us sentiments of awe for the CREATOR of all things, respecting whose omnipotence our ideas are raised a thousand-fold, by the contemplation of the objects to which we are introduced by the invention of these two instruments.

The Author claims the humble merit of introducing his fellow-creatures, in a pleasing and

popular manner, to the enjoyment of these contemplations, which cannot fail at once to make them wiser and better.

Books of Astronomy have hitherto deterred the inquisitive and young from perusing them, by their technical language, or by the want of those illustrative Plates of which this work proves the subject to be so susceptible. Some of the objects here introduced have never before been drawn, and others are only to be found in the voluminous transactions of learned societies, or in large and expensive works.

The Author believes, however, that the Plates will be found to be a pleasing, useful, and instructive part of his work, and, with their aid, he trusts that his Text will prove an agreeable introduction to the most sublime of sciences that has hitherto been produced.

WONDERS
OF
THE TELESCOPE.

THE Earth, on which we live, is an immense globe or sphere, twenty-five thousand miles round. This is a fact as certain and as well ascertained as any other with which we are acquainted. Standing on the sea-shore, and viewing, with a good telescope, the approach of a vessel, at first its top-mast only is seen; as it approaches nearer, the other parts of the mast will be visible, as if rising out of the sea; and at length the whole body of the ship appears. If the sea were an extended plane, the body of the ship, being so much larger than the mast, would be first in view, but, as this is not the case, and the pendant is first

visible, then the mast, and so on, gradually, till the vessel itself comes in sight, it is clear that the Earth and the water are convex, or round.

A more striking proof is this, that a ship, which sets out from any port, and continues to sail forward in the same direction, will in the course of time come to the same port again; but if the Earth were a flat surface, the farther the ship sailed, the farther would she be from port. Capt. Cook and others have sailed from different parts of Europe, in a westerly direction, and have, by continuing to sail in the same direction, after three or four years, found themselves at their own ports again.

The circular shadow of the Earth, as seen on the Moon during an eclipse of the Moon, is an ocular demonstration of the same principle.

The Earth is but one of several other round bodies like itself, called Planets, that circulate or move round the Sun in different periods of time; that is, the nearer a planet is to the Sun, the less time is its period of revolution.

To the Earth belongs another body, called the Moon, which goes round the Earth, in the same manner as the Earth itself moves about the Sun; and some of the other planets have similar moons. The Sun, the Planets, and their Moons, with other bodies, called Comets, taken together, are called the *Solar System*.

OF THE SOLAR SYSTEM.

The Solar System consists of the Sun in the centre; *seven* primary planets, viz. Mercury, Venus, the Earth, Mars, Jupiter, Saturn, and the Her-

schel, or Georgium Sidus; *eighteen* secondary planets, viz. the Moon belonging to the Earth, Jupiter's four satellites, Saturn's seven, and six belonging to the Herschel, besides an uncertain number of comets: in addition to these, there have been discovered, during the last few years, four other very small planetary bodies.

The SUN has been properly represented the soul, the animating principle of the system, as it not only produces all the necessaries of life, but has a particular influence in cheering the mind of man. With respect to the system to which we belong, the Sun is that luminary which enlightens all, and his presence constitutes day.

Great source of day! best image here below
Of thy Creator, ever pouring wide,
From world to world, the vital ocean round,
On nature write with every beam his praise.

THOMSON.

In the infancy of Astronomy, the Sun was reckoned among the planets, but it is now numbered among the fixed stars. It appears bright and large in comparison of them, because we keep constantly near the Sun, and are at immense distances from the stars. For a spectator, placed as near to any star as we are to the Sun, would see that star as large and bright as the Sun appears to us; and to a spectator, as far distant from the Sun as we are from the stars, the Sun would appear as small as the stars seem to us, divested of its attendant planets; and in numbering the stars, he would reckon it among them.

The Sun is about a million times larger than the Earth, and is at the amazing distance of ninety-five millions of miles from us; so that a cannon ball, travelling at the rate of eight

miles in a minute, would, even with that velocity, be more than twenty-two years in going from the Earth to the Sun. But the rays of light, or the indefinitely small particles that flow from the Sun, travel so fast, that they are only about eight minutes in coming to us from that body; in other words, they come with a velocity of about two hundred thousand miles in a second of time. What magnificent ideas of the great Creator do the facts, relating to this single body, inspire in the contemplative mind! But when the effects produced by this great Being are but slightly considered, what gratitude should they not call forth from those who daily rejoice under their influence! Let the heart, capable of sublime reflections, think upon what happens every bright morning in the spring. How striking the scene when the glo-

rious luminary scatters the clouds with its mild beams! As the illumination increases, the Earth seems to glow; darkness and gloom vanish at his appearance; and man, recollecting at the same moment his own weakness and meanness, and, nevertheless, such a vast apparatus created for his happiness, glories in his habitation, and beholds it embellished with renovated beauty. The lawn is refreshed by the coolness of the night, and the light of morning displays its increasing verdure. The flowers that enamel its surface glitter in the sunbeams, and, like the most brilliant stones, reflect a thousand mingled colours to the eye. The cheerful birds unite in choirs, and hail, in concert, the parent of life: not one is silent; all join, each in his different way, to shout their Maker's praise. All nature is enlivened by the

presence of the Sun, and gladdened by his gifts. Millions of glittering insects awake into existence, and flutter in his rays.

> The very dead creation, from thy touch,
> Assumes a mimic life.

The bleating flocks and lowing herds salute the welcome blessing. Who can behold with indifference a scene at once so magnificent, so beautiful, and so delightful? Besides all this,

> Bright legions swarm unseen, and sing, unheard
> By mortal ear, the glorious Architect,
> In this his universal temple, hung
> With lustres, with innumerable lights,
> That shed religion on the soul; at once
> The temple and the preacher!

The nearest planet to the Sun is MERCURY, which revolves about him in eighty-eight days: this is the length of his year. Mercury is the smallest of the seven primary planets; and,

being only about thirty-six or thirty-seven millions of miles from the Sun, is rarely seen by the inhabitants of the Earth. The velocity of Mercury about the Sun is at the rate of more than one hundred millions of miles in an hour. The inhabitants of the planet Mercury enjoy a light and heat seven times stronger than what we experience.

The second planet in order,

——————— Fair VENUS shines
Even in the eye of day; with sweetest beam
Propitious shines, and shakes a trembling flood
Of soften'd radiance from her dewy locks.
BARBAULD.

The distance of this beautiful planet from the Sun is computed at about sixty-six millions of miles. In bulk, Venus is not much less than the Earth. The length of her day and night is very nearly the same as ours, and the length of her year is near two hundred and

twenty-five of our days; of course, she travels at the rate of seventy-six thousand miles an hour. When this planet appears to the west of the Sun, she rises before him in the morning, and is called *the morning* star.

——————— Fair morning star,
That leads on dawning day to yonder world,
The *seat of man.*

MALLET.

And, when she is east of the Sun, she shines in the evening after he is set, and is then called *the evening* star. She is in each situation, alternately, between nine and ten months, and to these changes Milton alludes:

Fairest of stars, last in the train of night,
If better thou belong not to the dawn,
Sure pledge of day, that crown'st the smiling morn
With thy bright circlet.

The EARTH is the next planet in

the system, which revolves about the Sun in little more than three hundred and sixty-five days, at the distance of about ninety-five millions of miles from that luminary. The velocity of this body, in its path round the Sun, though but little more than half the velocity of Mercury, is at the rate of fifty-eight thousand miles an hour, or one hundred and twenty times swifter than the velocity of a cannon-ball. The diameter of the Earth is nearly eight thousand miles in length, and she turns on her axis in twenty-four hours, which is the length of our day and night. The equable motion of the Earth about its axis, and the velocity of its course round the Sun, are beautifully described by Milton, in few words:

——————— That spinning sleeps,
On her soft axle she paces even,
And bears us swift with the smooth air along.

The rotation of the Earth around her axis every twenty-four hours, from west to east, occasions an *apparent* motion of the heavenly bodies from east to west in the same time.

Beyond the orbit of the Earth is that of MARS, whose distance from the Sun is one hundred and forty-five millions of miles. His year is equal to nearly two of our years; his diameter is more than five thousand miles in length; his day and night thirty-nine minutes longer than ours; and his velocity round the Sun is computed at fifty-five thousand miles an hour.

Between the orbits of Mars and Jupiter, the small planetary bodies, lately discovered, revolve: these, on account of their diminutive size, have been termed asteroids by Dr. Herschel. At present, little is known of these bodies; they have been named Ceres,

Ferdinandea, Pallas, Juno, and Vesta. The largest of these, viz. the Ceres, is only about 160 miles in diameter.

JUPITER is the largest planet in our system; his diameter is more than ninety thousand miles long, and its bulk exceeds the bulk of Venus fifteen hundred times. Hence he is described, with regard to magnitude, as travelling

> With kingly state, the rival of the Sun.
>
> MALLET.

His distance from the Sun is four hundred and ninety-three millions of miles, and he travels at the rate of twenty-nine thousand miles in an hour. His revolution on his axis, or day and night, is not quite equal to ten hours, and his year to nearly twelve of our years. The four satellites of this planet are thus referred to by Mallet:

About him round *four* planetary moons
On earth with wonder all night long beheld,
Moon above moon, his fair attendants dance.

SATURN, next beyond Jupiter, revolves at almost double his distance from the Sun. His diameter is computed at seventy-eight thousand miles, and his diurnal rotation is estimated at nearly eleven hours. He travels with a velocity of twenty-two thousand miles an hour. This, till the discoveries of the great Herschel, was supposed to be the last planet in our system; its situation as such was beautifully described by Mallet:

Last, outmost Saturn walks his frontier round
The boundary of worlds; with his pale moons
Faint glimmering through the gloom which night has thrown
Deep-dyed and dead o'er this chill globe forlorn:
An endless desert, where extreme of cold
Eternal sits, as in his native seat.

How much more descriptive must

these lines be of the HERSCHEL planet, which is twice as far from the Sun as Saturn! The diameter of this "outmost" planet, this "boundary of worlds," is something more than thirty-five thousand miles; it travels at the rate of seven thousand miles an hour; and its year is equal to nearly eighty-two of ours.

Who can contemplate the Power which produced this system, without wonder and admiration!

With what an awful, world-revolving pow'r
Were first th' unweildy planets launch'd along
Th' illimitable void!—there to remain,
Amidst the flux of many thousand years,
That oft has swept the toiling race of men,
And all their labour'd monuments away!
Firm, unremitting, matchless in their course,
To the kind-tempered change of night and day,
And of the seasons ever stealing round,
Minutely faithful. Such the all-perfect Hand,
That pois'd, impels, and rules the steady whole.

THOMSON.

Besides the primary planets already noticed, we must not forget their satellites, which by astronomers are usually called secondary planets: these revolve round their primaries as centres, in the same manner as the primaries go about the Sun.

The most conspicuous of the satellites is the Moon, "the beauty of heaven, the glory of the stars." This, of all the celestial bodies next the Sun, is the most important to us, and has the most beneficial influence upon our globe.

Array'd in glory, and enthron'd in light,
She breaks the solemn terrors of the night.

BROOME.

What a beautiful picture has Mr. Pope drawn of a moon-light scene!

As when the Moon, refulgent lamp of night,
O'er heaven's clear azure sheds her sacred light,
When not a breath disturbs the deep serene,
And not a cloud o'ercasts the solemn scene,

Around her throne the vivid planets roll,
And stars unnumber'd gild the glowing pole;
O'er the dark trees a yellow verdure shed,
And tip with silver every mountain's head;
Then shine the vales, the rocks in prospect rise,
A flood of glory bursts from all the skies:
The conscious swains, rejoicing in the sight,
Eye the blue vault, and bless the useful light.

Such advantages as we derive from our Moon are undoubtedly experienced by the inhabitants of Jupiter, Saturn, and the Herschel, from each of their moons.

Our Earth is a moon to the Moon, only appearing thirteen times larger to her than she does to us. At *new* moon to us, the Earth appears to her *full.* What a majestic sight must that be in the heavens, which would appear from a body of light thirteen times larger than the full moon! The rotation of the Moon round the Earth is performed exactly in the same time

that she goes round the Earth; of course, the inhabitants of one-half of the lunar world must be totally deprived of a sight of the Earth, and remain ignorant of its existence, unless curiosity should lead them to explore the opposite hemisphere, where they may have a full and glorious sight of our globe, moving majestically through the heavens, and affording as much light to them as thirteen of our moons would at the full. In comparing it with the Sun, they may well say,

——— gives us his blaze again,
Void of its flame, and sheds a softer day.
THOMSON.

Or, according to another poet—

And see, Day's amiable sister sends
Her invitation, in the softest rays
Of mitigated lustre; courts thy sight,
Which suffers from her tyrant brother's blaze.
YOUNG.

Besides the Sun and planets, there are, belonging to the Solar System, other bodies, which are called comets. These are opaque and solid bodies, shining only by the light of the Sun; for when a comet comes to within a given distance from the Earth, it shines much brighter when it is on the same side of the Earth with the Sun, than when it is on the contrary side, which proves that it owes its brightness to that body. The comet which appeared in 1680, was observed to approach so near the Sun, that it became two thousand times hotter than red-hot iron, a heat that would have certainly dissipated it, if it had not been a very fixed and solid body.

A comet thus heated must retain its heat a long time. For a red-hot globe of iron an inch in diameter, exposed to the open air, scarcely loses all its heat

in an hour, but a larger globe will retain its heat much longer; and it has been calculated that a globe of red-hot iron, as large as our Earth, would scarcely cool in fifty thousand years.

We shall now proceed to a telescopic view of the principal bodies belonging to the Solar System, beginning with the Sun.

OF THE SUN,

AS VIEWED WITH THE TELESCOPE.

THE Sun, being evidently the source of light and heat, was considered by the ancients as a globe of pure fire. The discovery of the telescope, however, furnished the means of making a more accurate inquiry; and, from the dark spots found on many parts of his surface, that opinion was quickly shewn to be ill-founded.

THE SUN, AS SEEN THROUGH A TELESCOPE.

London: William Darton, 58, Holborn Hill; 7th mo. 29th. 1823.

These spots consist, in general, of a nucleus, or central part, which appears much darker than the rest, and seems to be surrounded by a mist, or smoke; and they are so changeable, in their situation and figure, as frequently to vary during the time of observation. Some of the largest of them, which are found to exceed the bulk of the whole Earth, are often to be seen for three months together; and when they disappear, they are generally converted into faculæ, or luminous spots, which appear much brighter than the rest of the Sun. About the time they were first discovered by Galileo, forty or fifty of them might be frequently seen on the Sun at a time; but, at present, we seldom observe many, and there have been periods of seven or eight years in which none could be seen.

When we look at the Sun through a

telescope, even of moderate magnifying power, and sometimes with the naked eye, we discover these black, or rather less bright, spots of various sizes and shapes. They will frequently vanish in a very short time after their first appearance, and sometimes travel over his whole disk, or visible surface, from east to west, when they disappear; and, after twelve or thirteen days, appear again, so as to be known by their magnitude and figure to be those that had disappeared before.

These solar spots have occasionally excited the attention of the most celebrated observers, and have been very differently explained. By some it has been supposed, that they are occasioned by the smoke and opaque matter thrown out by volcanoes, or burning mountains of immense magnitude; and that when the eruption is nearly

ended, and the smoke dissipated, the fiery flames are exposed, and have the appearance of the faculæ, or luminous spots. Others have imagined the Sun to be in a continual state of fusion, and that the spots we observe are the eminences of large masses of opaque matter, which, by the irregular agitations of the fluid, sometimes swim on the surface, and at other times sink and disappear. Others have supposed them to be occasioned by a number of planets which circulate round the Sun, at a small distance from his surface. The Sun itself has been called a globe of fire, and there have been calculations to ascertain the waste it would undergo by a gradual consumption, and its immense power of heating the bodies which approach it.

A long list of successive eminent astronomers, from Galileo down to the present time, have furnished us with

materials for a more accurate examination of this subject; and later observations, made with the assistance of more perfect and powerful telescopes, have determined that most, if not all the spots, are excavations in a coat of luminous matter which environs the Sun's body, and is probably of no great depth. There have been spots on his face so large as to be seen with the naked eye. In the year 1779, a remarkable one of this kind was distinctly and easily visible, whenever the Sun's brilliancy was reduced by a fog, or by guarding the eye with a smoked glass: through a telescope of great magnifying power, it appeared to be divided into two parts, the larger of which was calculated to be thirty-one thousand miles in length, and both together must certainly have extended above fifty thousand miles.

Dr. Herschel, whose immense tele-

scopes gave him so great an advantage in the examination of the heavenly bodies, had made the most accurate research on the nature of the Sun and his spots : he concluded that, in the instance of the large spot referred to, he viewed the real body of the Sun itself, of which, at other times, more is rarely to be seen than its shining atmosphere.

From a course of highly interesting observations, which this learned astronomer had pursued for many years, he was of opinion that the difference which we have been accustomed to imagine between the Sun and the rest of the planets, is in a considerable degree removed. Under these circumstances, said he, " the Sun appears to be nothing else than a very eminent, large, and lucid planet, evidently the first, or rather the only primary one of our

system, all the rest being truly secondary to it. Its similarity to the other globes of the Solar System, with regard to its solidity, its atmosphere, and its diversified surface ; to the rotation upon its axis, and the fall of heavy bodies on its surface, lead us to suppose that it is most probably also inhabited, like the rest of the planets, by beings whose organs are adapted to the peculiar circumstances of that vast globe."

It may be objected to the idea of the Sun's being habitable, that, as his heat is so considerable to us, at the distance of ninety-five millions of miles, the surface of the globe of the Sun itself must be scorched up beyond all conception. Dr. Herschel answered this, by many substantial proofs, drawn from natural philosophy, which shew that heat is produced by the Sun's rays only when

they act upon a calorific medium; they cause the production of heat, by uniting with the matter of fire which is contained in the substances that are heated, as the collision of flint and steel will inflame a magazine of gunpowder, by uniting with its latent fire, and bringing the whole into action. But a familiar instance or two of the manner in which the solar rays produce their effect, will bring this home to our most common experience.

"On the tops of mountains, and at heights to which the clouds seldom reach to shelter them from the direct rays of the Sun, we always find regions of ice and snow. Now, if the Sun's rays themselves conveyed all the heat we find on the Earth, it would of course be hottest in situations similar to the tops of mountains, where their course is least interrupted. But all those

who have ascended in balloons confirm the coldness of the upper regions of the atmosphere; and since, therefore, even on the Earth, the heat of any situation depends upon the facility with which the medium yields to the impression of the Sun's rays, we have only to admit, that on the Sun itself, the fluids composing its atmosphere, and the matter on its surface, are of such a nature as not to be capable of any excessive heat from its own rays.

"It is also a well-known fact, that the focus of the largest burning lens, thrown into the air, will occasion no heat in the place where it has been kept for a considerable time, although its powers of exciting heat when proper bodies are exposed to it, should be sufficient to melt or fuse the most refractory metals."

Dr. Herschel shewed that the lucid

substance of the Sun is not a liquid, nor an elastic fluid, but that it exists in the manner of luminous clouds swimming in the transparent atmosphere of the Sun; and he considered that there are two different regions of solar clouds, the lower of which consists of clouds less bright than those which compose the upper stratum.

Viewed through a telescope of great magnifying power, the Sun's face appears equally mottled all over, but the little unevennesses which produce this appearance are better seen near the middle of his disk, than towards the circumference, on account of his spherical form. The spots will, from the same circumstance, be seen of a roundish figure when they are near the middle of his disk, and oval when they remove towards the edges of it. Some parts will also be observed much

brighter than the general face; these are sometimes disposed in long streaks, and sometimes in small, but highly elevated and luminous spots.

Dr. Herschel, in consequence of the improvements in his telescope, and the advances in his knowledge of the construction of the Sun, rejected the old terms of *nuclei*, *penumbræ*, and *luculi*, by which the spots have been hitherto distinguished, and substituted those of openings, shallows, ridges, nodules, corrugations, indentations, and pores.

The definitions or meaning of these terms, with an account of the most striking appearances, will direct the young observer to the proper objects of inquiry, and will both give an interest to his own observations, and enable him to understand those of others.

Openings are places where the lumi-

nous clouds of the Sun are removed, so as to exhibit the opaque globe of the Sun through the aperture. The probable cause of openings is, that a wind, or gas, issues from the Sun's body through the smaller openings, and spreads itself on the luminous clouds, forcing them out of the way, and widening its passage. The direction and operation of this wind are not equally extended on all sides, but are frequently oblique, so that the luminous clouds seem to be driven, and form a large shallow on one side.

There is sometimes a difference in the colour of openings, apparently from a thin veil of luminous clouds hovering above them; when the openings are decaying, they frequently divide; the luminous passage across the opening at these times resembles a bridge thrown over a cave or hollow space: with a

telescope of great power the depth of these openings is easily visible.

Shallows are parts depressed below the general surface of the Sun, and are places where the luminous solar clouds of the upper regions are removed, and leave similar clouds visible in the lower regions, still covering the real body of the Sun. Their depth is also visible, and they frequently exist without openings in them. They either begin from the openings, or branch out from shallows already formed, and go forward. They seem to be occasioned by the wind or gas from the openings, which, by its propelling motion, drives away the luminous clouds from the place where it meets with the least resistance, or which, by its nature, dissolves them as it comes up to them. They have somewhat the appearance of a collection of dense tufted clouds.

Ridges are elevations above the general surface of the luminous clouds of the Sun. These have been seen of seventy-five thousand miles in length. They generally surround the openings, but are sometimes seen in other parts of the Sun's surface: they disperse very quickly.

Nodules are small, but highly elevated, luminous places, and, being never seen near the middle of the Sun's disk, they are supposed to be ridges fore-shortened to our view, by their situation on the Sun's spherical surface.

Corrugations are collections of smaller elevations and depressions of the luminous matter. They have a mottled appearance, consisting of dark and bright places. Many of the dark places are not round, but a little extended in different directions, and

appear to be lower than the bright places; and on favourable days the corrugated surface presents its elevations and depressions as distinctly as the rough surface of the Moon. It generally extends over the whole surface of the Sun. The dispersion of ridges and nodules produces the appearance of a corrugated surface. They frequently change their shape and situation, increase and diminish, divide and vanish very quickly.

The dark places of corrugations are *indentations.* They are extended over the whole surface of the Sun, and with a telescope of moderate magnifying power, they appear like points, or small specks.

Pores are the lowest places of indentations. They occasionally increase and become openings, and frequently vanish in a short time.

The young observer may view the spots and variegated surface of the Sun with a refracting telescope of two or three feet, or a reflecting one of twelve inches, eighteen inches, or two feet, taking the precaution to guard the eye with a smoked or dark-coloured glass, to take off the glaring light; or the image or picture of the Sun with his spots, &c. may be thrown into a dark room by means of a camera-obscura, or scioptric ball and socket, or through a telescope, and received on a semi-transparent screen, or a white sheet.

Besides the solar spots, the zodiacal light is a singular phenomenon which accompanies the Sun, and is usually attributed to the atmosphere. It begins to appear a little before sun-rise, and seems at first like a faint whitish zone of light, resembling the milky way, with its borders ill terminated,

and scarcely to be distinguished from the twilight which is seen commencing near the horizon. It is then but little elevated, and its figure nearly agrees with a spheroid seen in profile. As it rises above the horizon, it becomes brighter and larger to a certain point; after which the approach of day renders it gradually less apparent, till it becomes quite invisible.

Such, then, is the Sun:

Soul of surrounding worlds! in whom best seen
Shines out thy Maker! may I sing of thee?
'Tis by thy secret, strong, attractive force,
As with a chain indissoluble bound,
Thy system rolls entire: from the far bourne
Of utmost *Herschel* wheeling wide his round
Of eighty years; to Mercury, whose disk
Can scarce be caught by philosophic eye,
Lost in the near effulgence of thy blaze.

THOMSON.

OF MERCURY,

AS SEEN THROUGH THE TELESCOPE.

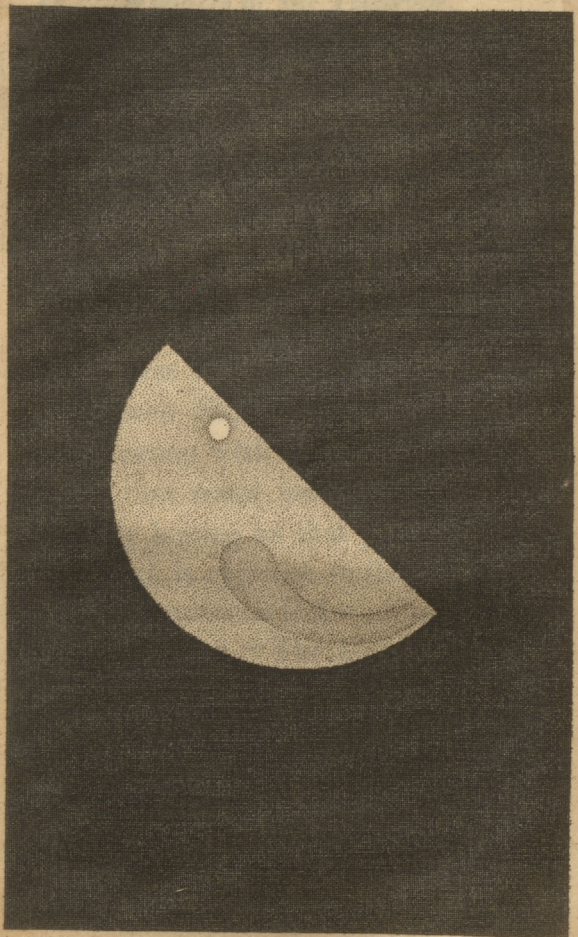
MERCURY is a small star, which emits a very bright light; but on account of his always keeping near the Sun, he is seldom to be seen; and when he does make his appearance, his motion towards the Sun is so swift, that he can only be discerned for a short time. Of course there is but little opportunity given to astronomers to examine it; when, however, it is looked at through a telescope that magnifies two or three hundred times, it appears equally luminous throughout his whole surface, without the least dark spot. He appears to have the same difference of phases, as will be described as belonging to the Moon, being sometimes horned, sometimes

gibbous, and sometimes shining, almost with a round face, though not entirely full, because his enlightened side is never turned directly towards us ; but at all times perfectly defined, without any ragged edge, and perfectly bright.

The great comet that appeared in the year 1744, came so near Mercury, that it was supposed the planet would have been disturbed by its attraction. Its situation with regard to the Sun is such, that water would be kept continually boiling on that part of its surface that is opposite to the Sun. To this circumstance Baker alludes in his poem, entitled " The Universe :"

First Mercury, amidst full tides of light,
Rolls next the Sun, through his small circle bright.
All that dwell here must be refin'd and pure ;
Bodies like ours such ardour can't endure ;
Our earth would blaze beneath so fierce a ray,
And all its marble mountains melt away.

The Planet Venus. Plate 3. p. 43.



London, William Darton, 58, Holborn Hill, 3d Month 29. 1823.

OF VENUS,

AS SEEN THROUGH THE TELESCOPE.

VENUS appears to us the brightest planet of the system ; she is to be distinguished from them all by a superiority of lustre ; her light is of a white colour, and is so considerable, that, in a dusky place, she projects a sensible shadow. She appears to us constantly near the Sun ; never farther from him than about forty-seven or forty-eight degrees. She is never seen at or near midnight, or in opposition to the Sun, but is visible to us only for three or four hours in the morning, or evening, according as she is before or after the Sun ; and hence it is that this planet has acquired the name of the Morning and Evening Star.

Fair Venus next fulfils her larger round,
With softer beams and milder glory crown'd:
Friend to mankind, she glitters from afar,
Now the bright Ev'ning, now the Morning Star.

BAKER.

If we view Venus through a good telescope of considerable power, when she follows the Sun on the eastern side, and appears above the horizon after sunset, we shall see her nearly round, and but small; she is, at that time, beyond the Sun, and presents to us her whole enlightened hemisphere. As she departs from the Sun towards the East, she increases in her apparent size, and is seen to alter her figure, abating of her roundness, and appearing successively like the Moon in the different stages of her decrease. At length, when she is at her greatest apparent distance from the Sun, she is like the Moon in her first quarter, and

appears as she does, when from a full she has decreased to a half moon.

After this, as she seems to approach the Sun, she appears concave in her illuminated part, as the Moon when she forms a crescent; and she continues thus till she is entirely hidden in the Sun's rays, and then, presenting to us her whole dark hemisphere, she becomes invisible.

When she leaves the Sun's rays on the western side, we see her in the morning just before day-break. In this situation, Venus is called the Morning Star, as in the other, she is called the Evening Star. It is at this time that she appears the most beautiful, like a fine thin crescent, of a very bright silver light. From this period she grows more and more enlightened every day, till she is arrived at her greatest apparent distance from the

Sun, when she again appears as a half moon, or as the Moon in her first quarter; if still continued to be observed with the telescope, she is found to be more and more enlightened, though she is all the while decreasing in magnitude, and thus goes on growing smaller and rounder, till she is again hidden, or lost in the Sun's rays.

Venus, when she appears in the shape of a crescent, and at the times of her greatest brightness, affords a more pleasing telescopic view than any other of the heavenly bodies; her surface is diversified with spots, like the Moon, and, by the motion of these, we discover the time she takes up in revolving upon her axis. With a very powerful telescope, mountains may also be seen, as on the Moon.

Both bright and dark spots have occasionally been seen on the face of

Venus, the most singular of which are represented in the plate. They can only be observed, however, with a very good telescope, and when the air is clear.

A day and a night in the planet Venus, are about as long as twenty-three days and nights and a half with us; and from her axis being very considerably inclined to her orbit, the variation of her seasons must be very great, and the length of her days and nights differ very much in proportion to each other. She seldom has the forenoon and afternoon of the same day of an equal length, and some parts of her surface enjoy the four seasons twice every year.

Venus is occasionally seen to pass over the disk or face of the Sun, having the appearance of a round dark spot. This appearance is called a

transit: it happens but very seldom; though there have been two within these fifty years, the one in June 1761, and the other in June 1769: another will take place in the year 1874.

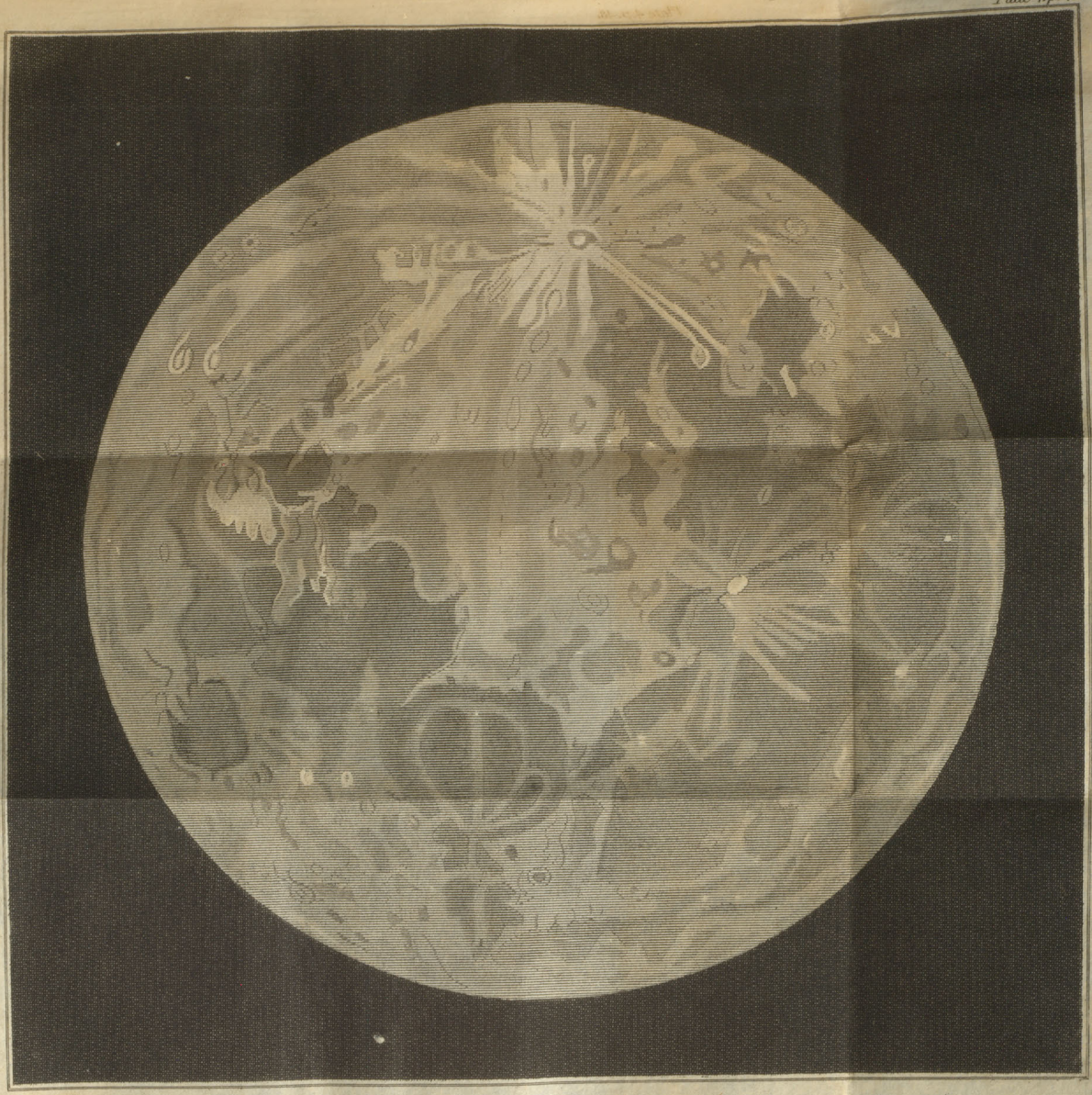
The inhabitants of Venus see the planet Mercury always accompanying the Sun; and he is to them, by turns, an evening and a morning star.

OF THE MOON,

AS VIEWED THROUGH THE TELESCOPE.

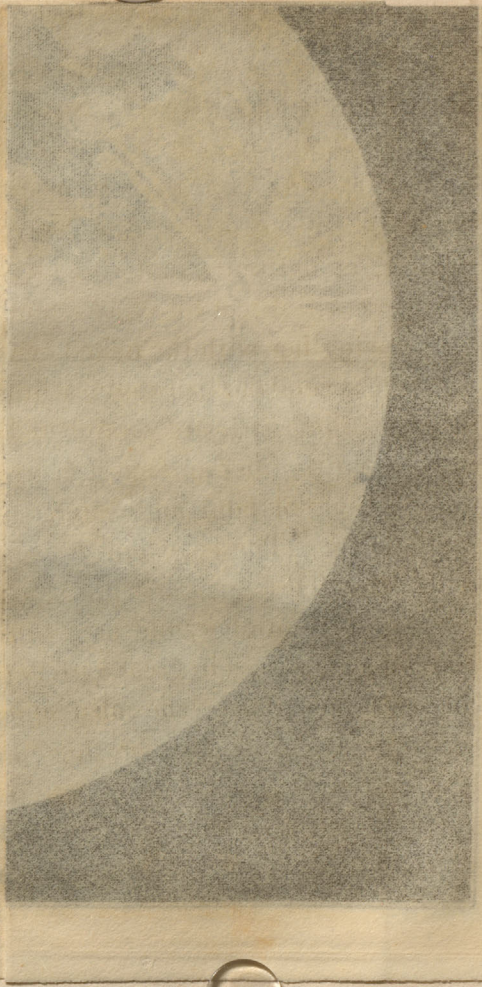
More distant still, our Earth comes rolling on,
And forms a wider circle round the sun:
With her the MOON, companion ever dear!
Her course attending through the shining year.
BAKER.

OF all the curious discoveries which the telescope has afforded us, those relating to the Moon are much the



THE MOON, AS SEEN THROUGH A TELESCOPE.

London: William Darton, 58, Holborn Hill, 7th. mo. 29th. 1823.



most interesting; she appears to us next in splendour to the Sun, and, being the inseparable companion of our Earth, and considerably nearer to us than any other of the heavenly bodies, is naturally that to which an observer will direct his chief attention.

Viewing her with the naked eye, we observe several darkish spots, which, it is easy to imagine, are produced by a breaking up of her surface into irregular portions of land and water, as on our Earth. These, when examined with the telescope, are prodigiously increased in number, and are found to extend themselves in great variety over her whole surface; she also appears very plainly to be more protuberant in the middle than at the edges, or to have the figure of a globe, and not a flat circle, as to the naked eye.

Some remarkable spots are con-

stantly found, in dark shadows, on the side opposite to the Sun, and light on the side next to him: other spots are as constantly observed to be illuminated on the farthest side, and dark on the nearest. Both these shadows become shorter, as the Sun shines more directly on her face, or as she approaches the full; and, at the time of complete full moon, they disappear altogether. During the third and last quarters, the shadows appear again; but all fall towards the contrary side of the Moon, though still with the same distinction, namely, that one set of spots are dark and shady on the side farthest from the Sun, and the other dark on the side near the Sun.

Astronomers infer from hence, that the first sort of spots are hills, and the latter, valleys. Indeed, if we compare these appearances with what we ob-

serve of the effect of sunshine on the hills and valleys of the earth, we shall, without difficulty, agree to their being hills and hollows also.

When the Moon is horned and gibbous, one side appears exactly defined and circular, but the other very ragged and uneven. There is, then, no regular line bounding light and darkness, but the confines of these parts appear, as it were, toothed, and cut with innumerable notches and breaks ; and, even in the dark part, near the borders of the shining surface, small spaces may be seen, which are illuminated by the Sun. About the fourth or sixth day after new Moon, some lucid points may be perceived, like rocks or small islands, within the dark body of the Moon ; near the southern edge, other little spaces may be observed, which join to the enlightened surface,

but project into the dark part. These will be found to change their figure gradually, till, at length, they come wholly within the illuminated face, and have no dark parts round them at all. Other shining spaces may be observed to arise in succession, and appear within the darkened part of the Moon, which, before, were totally immersed in shadow, and consequently invisible. In the decreasing phases of the Moon, the contrary may be observed; the lucid spaces, which were before included in the general illuminated surface, gradually recede from it, and, remaining visible for some time in their insulated state, disappear altogether. These, also, are facts which tend to prove the shining points to be higher than the Moon's general surface.

The appearance of these enlightened

spots, before and after the rest of the surface, furnishes an easy method to practical astronomers, to determine the actual height of the mountain to which they belong. Some of them are found to be more than one mile and a half high.

Where mountains rise, umbrageous dales descend,
And caverns deep, as optic tube descries.

THOMSON.

It has been ascertained, with telescopes of great magnifying power, that volcanic eruptions exist in different parts of her surface, similar, in appearance and effect, to our volcanic mountains of Ætna and Vesuvius. The large masses of stone which are said to fall from the clouds, are imagined by some to be projected with such violence from these lunar volcanoes, as to come within the influence of

the Earth's attractive power, and so brought to her surface.

The highly-interesting appearance of the Moon, as well from its frequent change of figure as its vicinity to us, naturally made it an object of early examination for the telescope. We find, accordingly, the inventors of the instrument were the first who observed the inequalities of her surface. These discoveries were followed with so much attention and industry, by succeeding astronomers, that drawings, or maps, of her face, were made within a few years; and these have been gradually perfected with the improvements of the instrument.

The figure and situation of every spot is delineated as they appear through a telescope, which magnifies about two hundred times, and are

each distinguished by a proper name. Riccioli, Cassini, and others, portioned out the lunar regions among those philosophers and astronomers who had distinguished themselves in the science, giving the names of the most celebrated characters to the largest spots, and those of less eminence to the smaller. Another astronomer, Hevelius, denoted the different parts of the Moon by such geographical names as belong to the several islands, countries, and seas, of our Earth; but without regard to similarity of situation or figure. Riccioli's method, however, is now generally followed: the names of Copernicus, Tycho, Galileo, &c. seeming more appropriate to the subject than those of Egypt, Africa, the Mediterranean Sea, &c.

The Moon being an opaque body, like the Earth, possessing no native

light, but shining entirely by light received from the Sun, and reflected to us from her surface, it follows, that, whilst that half of her which is toward the Sun is enlightened, the other half must be dark and invisible; and she disappears when she comes between us and the Sun, because her dark side is then towards us.

Whilst she is making her revolution round the heavens, she thus undergoes a continual change of appearance. She is sometimes on our meridian at midnight, and therefore in that part of the heavens which is opposite to the Sun: in this situation she appears with a face completely circular, and is said to be a *full Moon.* As she moves eastward, a portion of her dark side comes forward on the western side, and, in a little more than seven days, comes to the meridian, at about

six in the morning, having the appearance of a semicircle, with the convex side turned towards the Sun: in this state we call her a *half Moon*. Continuing to travel eastward, her deficiency on the western side increases, and she assumes the form of a crescent, with the convex side still turned towards the Sun: this crescent gradually becomes more slender, till, about fourteen days after the full Moon, she is so near the Sun, that she is rendered invisible to us, from the superior splendour of that body. About four days after this disappearance, she may be seen in the evening, a little to the eastward of the Sun, in the form of a fine crescent, as before, but having its convex side turned *from* the Sun. Travelling still towards the east, the crescent becomes wider; and, when the Moon comes to the meridian,

about six in the evening, she again bears the appearance of a bright semicircle, with the same difference that we observed of the crescent: that is, its convex side is now turned *from* the Sun. Advancing still more to the eastward, the semicircular Moon gradually widens into an oval shape, and, at last, in about twenty-nine days and a half from the last opposition to the Sun, she is again in the same situation, and appears a full Moon.

The full Moon is a very beautiful sight through a telescope of moderate magnifying power, and exhibits a great variety of lustre and colour:

——————————The Moon
Full orb'd, and breaking through the scatter'd clouds,
Shews her broad visage in the crimson'd east,
Turn'd to the Sun direct her spotted disk,
Where mountains rise.

The mountains are, however, best observed at the time of her increase and decrease.

Different conjectures have been formed respecting the matter of which the brilliant spots are composed. Some have been so taken with their beauty, as to imagine them to be rocks of diamonds; it seems, however, most reasonable to conclude, that they are the tops of mountains, which, by reason of their elevation, are more capable of reflecting the Sun's light to us than the lower parts. Though philosophers have differed widely in their ideas of the materials of the Moon's mountains, there is fortunately no diversity of opinion respecting their use to us. If she were smooth and polished, like a mirror, or covered with water, she would not reflect and distribute the light she receives from the Sun. In

some positions, she would shew us his image no larger than a single point, and with a lustre that would injure our sight; but, roughened by these hills and valleys, her surface returns the Sun's light to us in an equal and pleasant manner, and enables us to examine her with ease and precision.

An observer of the Moon will soon remark, that we see nearly the same face during her whole revolution, or that one-half of her surface is never visible to us. This arises from her having two motions, which, with respect to our view of the Moon, counteract each other. Her revolution round the Earth is performed *toward the east*, in somewhat more than twenty-seven days; while a motion she has on her own axis produces one revolution in the same time, but performs it *toward the west*, so that one of these

motions turns as much of her surface from us as the other turns toward us. If the Moon be observed very attentively through a whole lunation, it will yet be found, that, in one part of it, a small portion of her face on the eastern side will be carried out of sight, as if by the motion on her axis, and a similar portion on the western side will be brought forward. In another part of her revolution, the contrary will be seen; the portion so brought forward on the western side will disappear, and the eastern portion be brought in view. This irregularity is called the Moon's *libration in longitude.*

There is, besides this, another sort of libration, which arises from the axis of the Moon being inclined to the plane of her orbit; on this account, sometimes one of her poles is inclined

toward the Earth, and sometimes the other. In consequence of this, we see more or less of her polar regions in different parts of her revolution, and therefore we can call this irregularity her *libration in latitude.*

Such are the principal phenomena that distinguish the Moon; and it may be worth while to reflect upon some of the signal benefits of which this body is productive to our globe. How cheerless and uncomfortable would be our nights, were we always destitute of the light which this sister-orb, our faithful and inseparable companion, dispenses! How highly useful are even her eclipses, in our astronomical, geographical, and chronological calculations! How salutary, too, is her attractive influence, which sways the ocean, and actuates the world of waters; which swells the tides, and

perpetuates the regular returns of ebb and flow; and which, by these means, not only preserves the liquid element itself from putrefaction, but the surrounding continents from infection and disease!

——————— The horned Moon renews
Her waning light, and her whole visage shews:
Fulfils her course in circles yet unknown,
And cheers mankind with lustre not her own.
Pale terror flies before her friendly ray,
The traveller, benighted, finds his way:
Her destin'd rule o'er ocean she presides,
And pours upon the shores the lagging tides.

BAKER.

OF MARS,

AS SEEN THROUGH THE TELESCOPE.

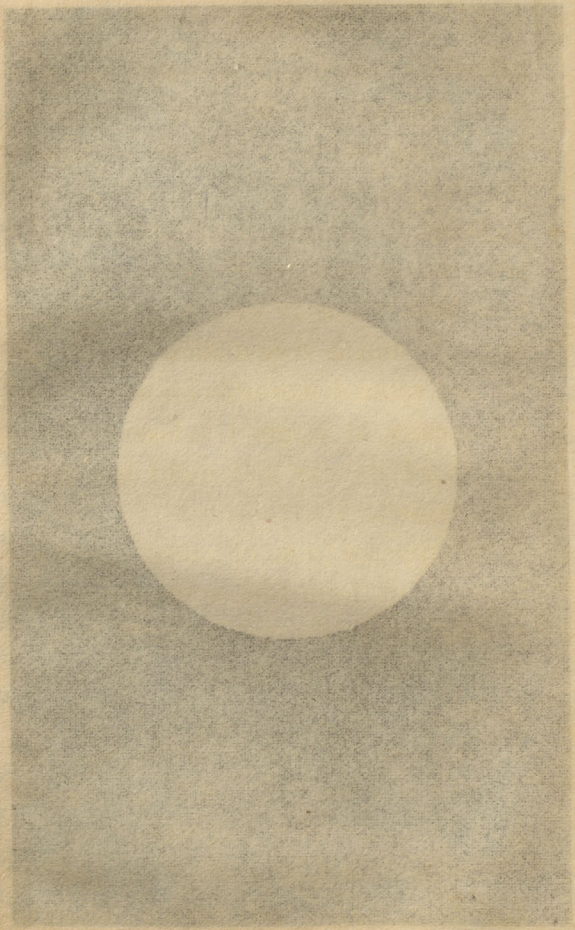
See Mars, alone, runs his appointed race,
And measures out exact the destin'd space:
Nor nearer does he wind, nor farther stray,
But finds the point whence first he roll'd away.
BAKER.

WITH the assistance of the telescope, this planet exhibits larger and more remarkable spots than any of the others. This has been examined with great care by Dr. Herschel, for the purpose of determining the figure of the planet, and the position of its axis.

The belts and cloudy appearances on this planet are found to change their shape and arrangement very frequently. Very bright and shining spots have been observed about the

The Planet Mars, Plate 5. p.64.

London, William Darton, 58, Holborn Hill, 7th Month 29. 1826.



poles of Mars; they are supposed to be produced by those parts of his surface being intensely frozen, or covered with snow.

Mars, in appearance, is the least splendid of all the planets; its orbit lies between that of our Earth and Jupiter; but is very distant from both. By the spots discernible on its surface, by means of a good telescope, the length of its day and night has been ascertained.

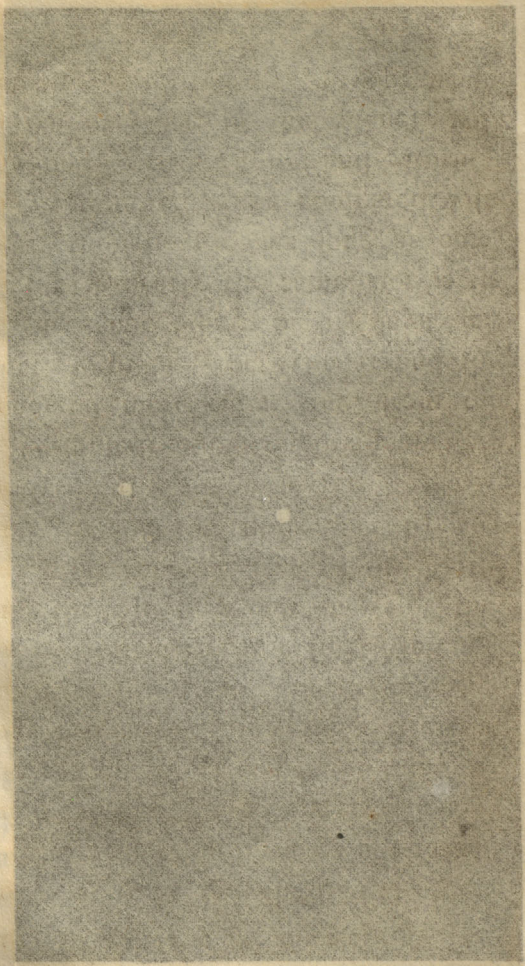
He appears to us of a dusky reddish colour, and, from this, some have supposed that he is encompassed with a thick cloudy atmosphere, similar to ours.

When in opposition to the Sun, he is five times nearer to us than when in conjunction. This has a very visible effect on the appearance of the planet, and causes him to seem much larger

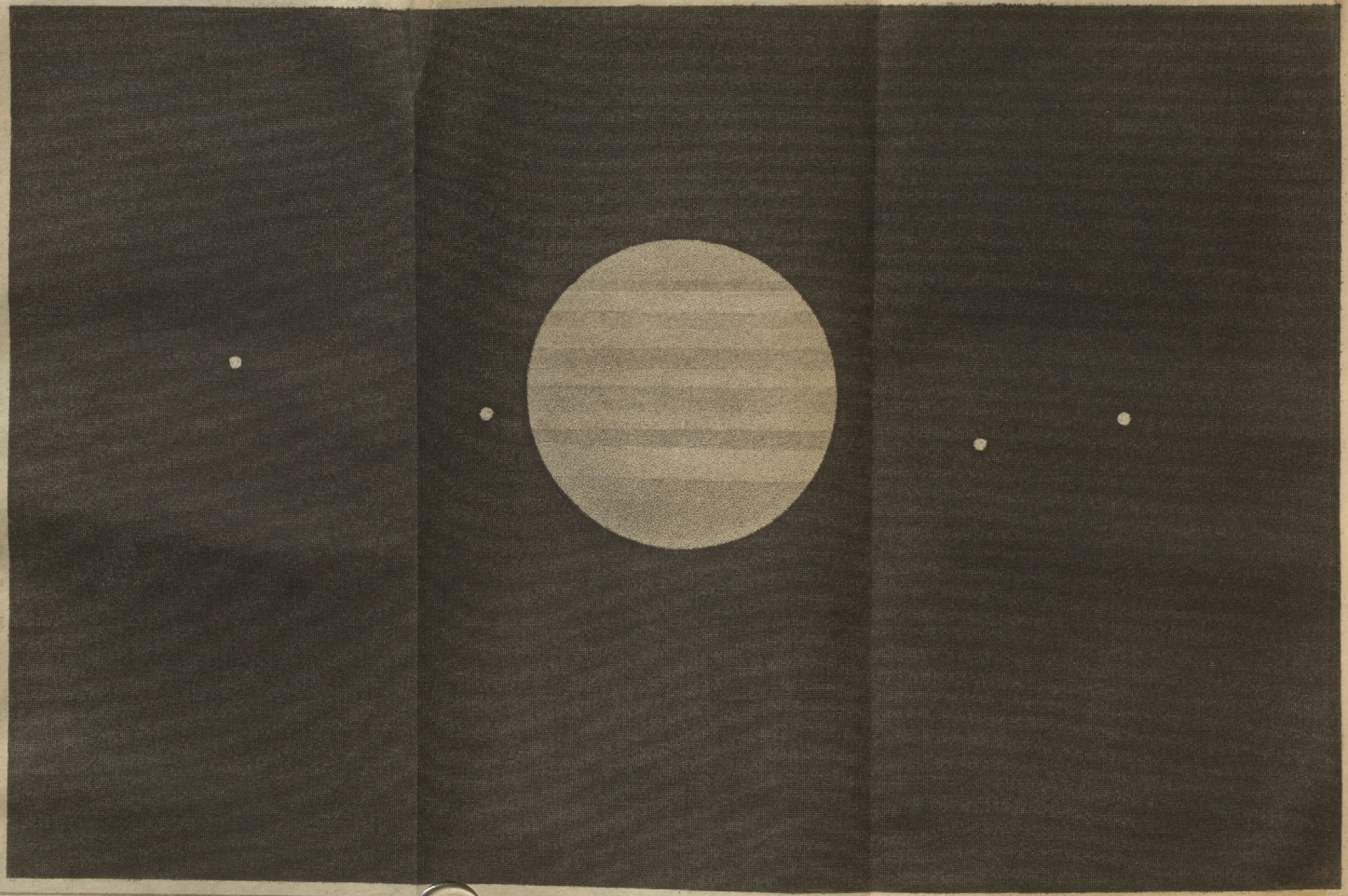
to us at some periods than at others. In the year 1719, his apparent magnitude and brightness were so much increased, that, by the uninformed, he was taken for a new star. Mars, at its quadratures, appears gibbous, but never horned, like Venus, Mercury, and the Moon, which shews (1) that his orbit includes that of the Earth, and (2) that he shines not by any native light of his own.

Our observations on this planet are rendered more interesting, from the analogy there is between it and the Earth. The length of his days and nights is nearly the same, nor is its year, though twice as long as ours, very dissimilar, when compared with the long years of Jupiter and Saturn.

An observer, in this planet, will seldom see Mercury, except when he sees it passing over the Sun's



The Planet Jupiter, and his Four Satellites, as seen through a Telescope. Plate 6. p.67.



London: William Darton, 58, Holborn Hill, 7th Month 29. 1823.

disk. Venus will appear to him at about the same distance from the Sun as Mercury appears to us. The Earth will appear about the size of Venus, and constantly near the Sun; and will be, by turns, a morning and evening star to the inhabitants of Mars, as the planet Venus is to us.

OF JUPITER,

AS SEEN THROUGH A TELESCOPE.

THE appearance of the planet Jupiter, through a telescope, opens a vast field for interesting inquiry. His surface is not equally bright, but is variegated with certain bands or belts, of a darkish dusky appearance; they run parallel to each other, and are continued quite round the planet's body. They are not regular or constant in

their appearance: sometimes only one is seen; at other times six, or even eight. The breadth of them is likewise variable; one belt sometimes growing narrow, while another, in its neighbourhood, becomes broader, as if one had flowed into the other: in these cases, an oblique belt has been observed to lie between them, as if for the purposes of forming a communication. Sometimes one or more spots are formed between the belts, which increase till the whole is united in a large dusky belt.

There are also bright spots to be discovered on Jupiter's surface; these are rather more permanent than the belts, and re-appear after unequal intervals of time. The remarkable spot by whose motion the rotation of Jupiter on his own axis was first ascertained, disappeared in the year 1694, and

was not seen again till 1708, when it re-appeared exactly in the same place, and has been occasionally seen ever since. The disappearance and re-appearing of the spots are, however, by no means so curious as the changes that have been observed in the belts.

Another remarkable telescopic appearance of this planet is produced by four satellites, or moons, which revolve about him at different distances: they are invisible to the naked eye, but through a telescope they make a beautiful appearance. As our Moon turns round the Earth, enlightening the nights by reflecting the light she receives from the Sun, so these may also be supposed to enlighten the nights of Jupiter, and move round him in different periods of time, proportioned to their several distances; and, as the Moon keeps company with the Earth

in its annual revolution round the Sun, so these accompany Jupiter in his course.

In speaking of these satellites, we distinguish them according to their places, into the first, the second, and so on. By the first, we mean that which is nearest to the planet.

Their motion round him is performed in a circular path; but, viewing it edgewise, as we do, it appears an extremely narrow oval, and consequently the apparent path of the bodies differs but little from a straight line; and we see them move backward and forward on each side of the planet, and occasionally pass both before and behind it.

When a satellite is in its superior semicircle, or that half of its circular path which is more distant from us than Jupiter, its motion appears direct

to us; and when it is in its inferior semicircle, or that half of its circular path which is nearer to us than Jupiter, its motion appears in a contrary direction. Both these motions seem quickest when the satellites are nearest the centre of the planet, and slower when they are more distant: at the greatest distance they appear stationary for a short time.

These satellites and their planet mutually eclipse each other, in the same manner as do our Earth and the Moon. But there are here three cases in which the satellites disappear to us.

The one is, when the satellite is directly behind the body of its planet, with respect to the *Earth.* This is called an *occultation* of the satellites.

Another is, when it is interposed between the Earth and its own planet;

for then it cannot be distinguished from the planet itself.

The last is, when it is directly behind the planet, with respect to the *Sun*, and so falls into its shadow, and suffers an eclipse similar to that of the Moon when she falls into the shadow of the Earth.

It is not often that a satellite can be discovered upon the disk of Jupiter, even with powerful telescopes, except at its first entrance, when, from its being more directly illuminated by the rays of the Sun than the planet itself, it appears like a lucid spot upon it. Sometimes, however, a satellite is seen passing over the disk, like a dark spot: this has been attributed to spots on the surface of the satellite, and that with the more probability, as the same satellite has been known to pass over

the disk at one time as a dark spot, and at another time to be so luminous as only to be distinguished from the planet itself at its coming on and going off.

The beginnings and endings of these eclipses are easily seen by a telescope, when the planet is in a proper situation; but when it is in conjunction, or in the same quarter of the heavens with the Sun, the brightness of that luminary renders both the planet and satellites totally invisible to us.

It was by observing these eclipses, that it was discovered that light is not progagated instantaneously, though it moves with extreme velocity. A ray of light is found to travel from the Sun to the Earth in about eight minutes of time, thus moving at a rate of two hundred thousand miles per second. They also furnish astronomers with an

easy method of determining the longitude.

Jupiter is situated, in the Solar System, between the planets Mars and Saturn, and at a distance of nearly five hundred millions of miles from the Sun. His diameter is ninety-four thousand of our miles; about twelve times greater than our Earth.

In some parts of his orbit he is much nearer to the Earth than in others, and then, of course, appears considerably larger and more luminous than at other times.

The days and nights of Jupiter are of an equal length, each being about five hours long; and, from the axis of his diurnal motion being nearly perpendicular to the plane of his annual motion, or path round the Sun, there is consequently very little difference in his seasons.

To the inhabitants of this planet, his satellites will appear almost as large as our Moon does to us; but the Sun will not appear to be a fifth part of the size he seems to us. The four Moons must afford a very curious and pleasing effect to the inhabitants of Jupiter; for sometimes they rise all together, and sometimes they are all on the meridian together, besides frequent eclipses.

More yet remote from day's all-cheering source,
Vast JUPITER performs his constant course;
Four friendly *Moons*, with borrow'd lustre, rise,
Bestow their beams benign, and light his skies.
BAKER.

An observer, in Jupiter, will never see either Venus, Mercury, the Earth, or Mars, because, from the immense distance at which he is placed from them, they must appear to accompany the Sun, and to rise and set with him.

The heavenly bodies which he will have for the objects of observation, are, his own four Moons, the planet Saturn, with his ring and satellites, and probably the Herschel planet.

OF SATURN,

AS SEEN THROUGH A TELESCOPE.

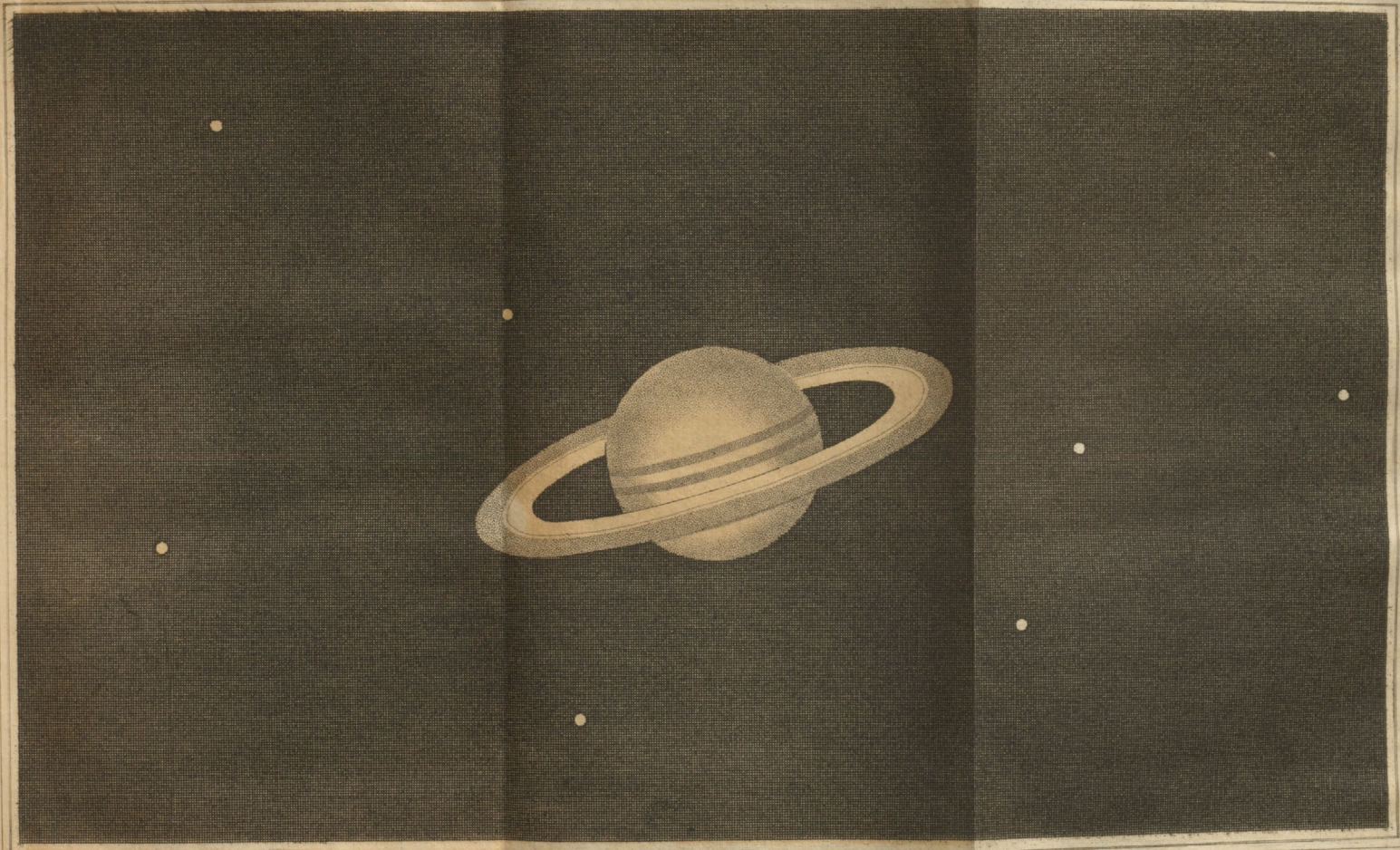
TILL Sir Wm. Herschel's discovery of the planet called after himself, forty-two years ago, Saturn was considered the most remote planet in our system. He shines with a pale and feeble light, less bright than Jupiter.

Farthest and last, scarce warm'd by Phœbus' ray,
Through his large orbit Saturn wheels away:
How great the change, could we be wafted there!
How slow the seasons! and how long the year!

BAKER.

The uninformed eye does not ima-

The Planet Saturn, his Ring, and Seven Satellites, as seen through a Telescope. Plate 7. p.76.



London: William Darton, 58, Holborn Hill 4th Month 29. 1823.

gine, when it is directed to this little speck of light, that it is viewing a large and glorious globe, one of the most stupendous of the planets, whose diameter is seventy-eight thousand of our miles.

One of the first discoveries of the elescope, when brought to a tolerable degree of perfection, was, that Saturn did not appear globular like the other planets. Galileo, in the year 1610, imagined it to be composed of three stars or globes, a larger in the middle, and a smaller on each side; and he continued his observations till what he thought the two lesser stars disappeared, and this planet looked like the others. Farther observation shewed that what Galileo took for two stars were parts of a ring. This singular and curious appendage to the planet Saturn is a broad, opaque ring, encom-

passing the body of the planet without touching it: like the horizon of an artificial globe, it appears to be suspended round the planet, and to keep its place without any immediate connexion with it. But

> ——————— even here the sight,
> Amid these doleful scenes, new matter finds
> Of wonder and delight!—a mighty *ring!*
> MALLET.

This appendage to the planet Saturn is still one of the most curious astronomical phenomena with which we are acquainted.

By what means it is suspended, or of what it is composed, we yet remain ignorant. It has been supposed by some to be a bright and permanent cloud, and by others, a vast number of satellites disposed in the same plane, and which, at this immense distance, appears as a mass of light.

Of its use to the inhabitants of the planet, we are as uninformed as of its nature, though perhaps it might be reasonably imagined to be intended to afford them light.

The space between the ring and the globe of Saturn is supposed to be rather more than the breadth of the ring itself; the greatest diameter of the ring is in proportion to that of the globe, as seven to three; and its breadth is about twenty-one thousand of our miles. It puts on different appearances to us, sometimes being seen quite open, or as a wide oval, and at others, only as a single line.

When our eye is in the plane of the ring, or looking at it directly on the edge, it is invisible to us; and it is in this situation twice in each revolution of the planet; that is, once in about fifteen years: at these times, he appears

quite round for nine or ten months together.

The ring was invisible to us in the year 1818, and has, since that time, been gradually increasing in light and breadth, and presenting a beautiful object for the telescope. This will continue for a year or two longer, after which both will again decrease, till, as before, after an interval of fifteen years, in the year 1833, the ring will be again edgewise to us, and invisible.

When the ring appears of an oval shape, the parts about the ends, which project, as it were, on each side of him, are called the *ansæ*.

With telescopes of great magnifying power, two belts or stripes have been discovered on Saturn: they appear parallel to the ring, and are supposed to be permanent.

Besides the ring, Saturn is also equipped with seven attendant moons or satellites, which move about him at different distances in a way similar to those of Jupiter; in reference to which, the poet says,

> One *Moon* on us reflects its cheerful light;
> There, seven attendants brighten up the night:
> Here, the blue firmament bedecked with stars;
> There, over head a lucid *arch* appears.

The plane on which they move is so considerably inclined to the plane of the planet's path about the Sun, that they very seldom appear to us to pass either across or behind him; so that their eclipses are not near so frequent as those of Jupiter. They are so small, with respect to their distance from us, as not to be easily visible, even with a good telescope, unless the air is exceedingly clear.

The Sun's disk appears ninety times

less to an inhabitant of Saturn than it does to us; but yet the quantity of light he affords them is more considerable than the great distance of the planet would lead us to suppose: it is at least five hundred times stronger than the light which we receive from the full Moon.

OF THE HERSCHEL PLANET,

AS SEEN THROUGH THE TELESCOPE.

WITHOUT the assistance of the telescope, the wonders of which we endeavour to set forth and illustrate in this little work, this planet would certainly never have been discovered. It was first observed by Mr. (late Sir W.) Herschel, on the 13th of March, 1781, near the foot of Castor, and his attention was arrested by its steady light.

On applying to the observation a higher magnifying power to the telescope, it appeared to increase in diameter, which was a certain proof that it could not be a fixed star. The news of the discovery was spread in a short time over the whole of Europe. Many foreign astronomers contended that it was a comet; but, by our own countrymen, it was very soon ascertained to be a new planet; and the circumstances which led to the discovery were, its vicinity to the ecliptic, and the direction of its motion. It is found to revolve in an orbit that is nineteen times farther from the Sun than the Earth's orbit; of course, it enjoys three hundred and sixty-one times less light and heat from the Sun than we experience. Still the proportion of light is considerable; it has been calculated, and found to be equal to

the effect of two hundred and forty-eight of our full moons. In reference to its remote situation, when compared with our own, we may well say,

From *earth*, how large, how strong the Sun's
bright ball!
But seen from *thence*, how languid and how small!
When the keen north, with all its fury blows,
Congeals the floods, and forms the fleecy snows,
'Tis heat intense to what can *there* be known;
Warmer *our* poles than is *its* burning zone:
Who there inhabit, must have other powers,
Juices, and veins, and sense, and life, than ours.
One moment's cold like theirs would pierce the
bone,
Freeze the heart-blood, and turn us all to stone.

Yet there is every reason to believe that even this planet is inhabited by some race of beings; that the Herschel, as well as our own globe, is the abode of happiness to millions, who rejoice in the Creator's goodness; not, indeed, by means that we can compre-

hend, nor by laws that we can describe: but He who formed the world, and who has given to it six Moons, to enlighten it during the Sun's absence, can adapt the inhabitant to the habitation.

Strange and amazing must the difference be,
'Twixt this dull planet and bright *Mercury*:
Yet reason says, nor can we doubt at all,
Millions of beings dwell on either ball,
With constitutions fitted for that spot
Where Providence, all-wise, has fix'd their lot.

BAKER.

OF THE TELESCOPIC APPEARANCE OF COMETS.

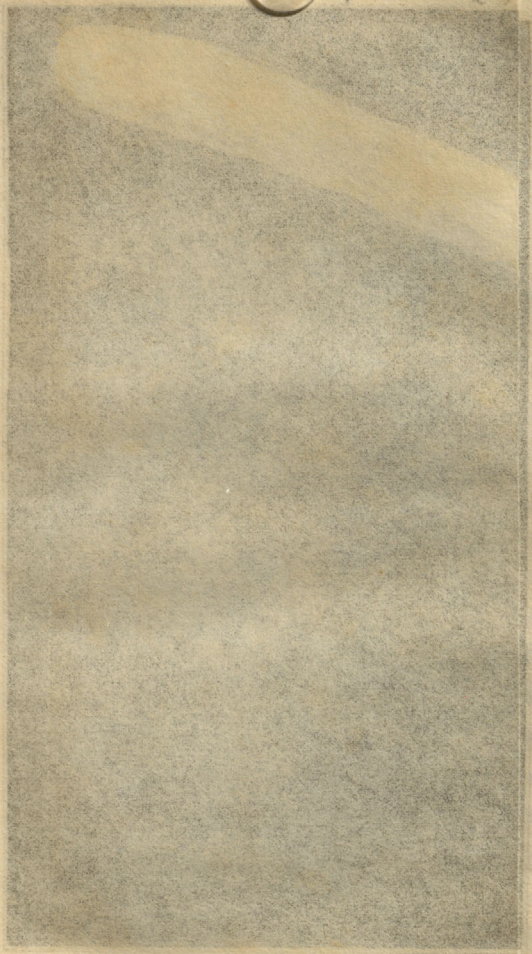
COMETS, seen through a telescope, have a very different appearance from any of the planets; they also differ much among themselves. A comet seems to consist of a body which shines

by the reflected light of the Sun, and is encompassed with an atmosphere of apparently fine matter, resembling that of the Aurora Borealis: this is called the head of the comet, and the internal part, the nucleus.

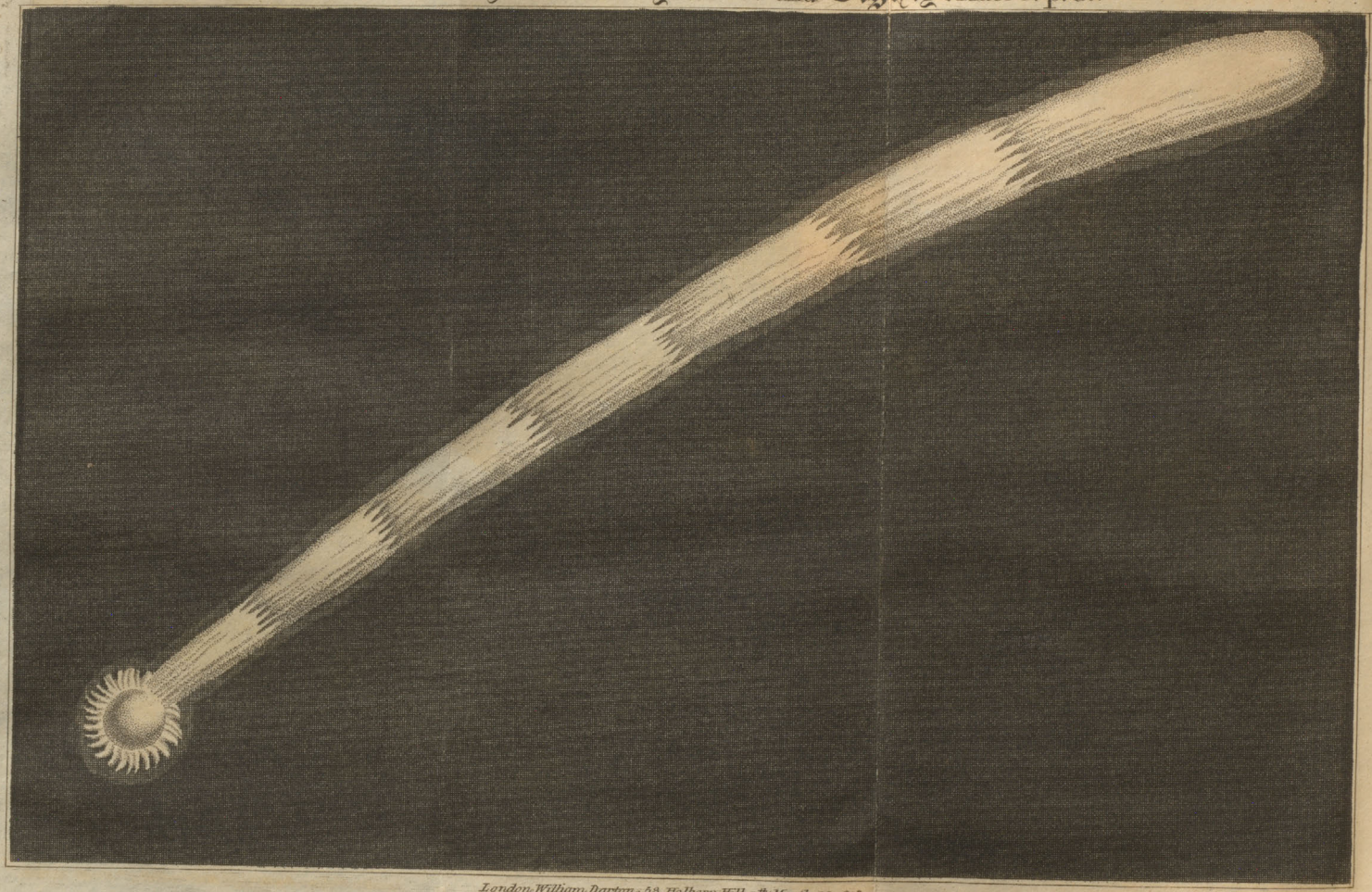
When a comet arrives at a certain distance from the Sun, an exhalation arises from it: this is called the tail, and is always directed to that part of the heavens opposite to the Sun, and increases in dimensions and brightness as it approaches that luminary.

These singular bodies traverse the heavens in every direction, and have been seen so frequently, and under so many different appearances, that their number is not correctly ascertained; it is supposed, however, to exceed five hundred.

The velocity with which they seem to move is variable in every part of



The Comet of Sixteen Hundred and Eighty. Plate 8. p. 87.



London: William Darton, 58, Holborn Hill, 7th Month 29, 1823.

their path about the Sun: when they are near the Sun, they appear to move with great swiftness, and, when very remote from him, their motion is inconceivably slow.

Various different opinions have been entertained of their nature; but it is now generally allowed that they are a sort of planets, which move about the Sun in very long and narrow ovals, or elipses.

The figure in Plate 7, is a representation of the great comet which appeared in the year 1680: this is remarkable from its near approach to the Sun. Sir Isaac Newton calculated that it came so near to it, as at one time to be only one-sixth part of the Sun's diameter from his surface; its rate of travelling was, in that situation, also calculated to be above eight hundred and eighty thousand miles per hour.

Will it not astonish the youthful reader, that, though this body travelled almost two thousand times faster than a cannon-ball, yet it drew after it a tail of fire estimated at eighty millions of miles in length? How amazing is it, that this stupendous body, traversing the immensity of the creation with such a rapidity, and at the same time wheeling about in that line which its great Creator prescribed to it, should move with such inconceivable velocity, and likewise with such exact regularity! How spacious must the universe be, that gives such bodies as these their full play, without suffering the least disorder or confusion by it! With what a glorious exhibition must those beings be entertained, that can look into this great theatre of nature, and see myriads of these tremendous objects wandering through those immeasurable depths of ether, and running

their appointed courses! Our eyes may hereafter be strong enough to command this magnificent prospect, and our understandings able to find out the several uses of these immense parts of the universe. In the mean time, they are very proper objects for our imagination to contemplate, that we may form more extensive notions of Infinite Wisdom and Power, and learn to think humbly of ourselves, and of all the little works of human invention.—*Guardian*, No. 103.

It is true that comets have been looked upon as forerunners of some dreadful calamity; of some terrible destruction which awaits a guilty nation; and when once such a fancy takes possession of the vulgar, nothing is more easy than to find some event to correspond with the superstitious notion. Philosophers now know bet-

ter; but poets have, in all ages, taken advantage of the credulity of the common people. Thus Dr. Young:

Hast thou ne'er seen the comet's flaming flight?
Th' illustrious stranger passing terror sheds
On gazing nations, from his fiery train
Of length enormous.

And Milton compares his Satan to a comet; and its tail is described as setting fire to the sky:

Incens'd with indignation, Satan stood
Unterrified, and like a comet burn'd,
That fires the length of Ophiucus huge
In th' arctic sky, and from his horrid hair
Shakes pestilence and war.

More of the properties of these blazing stars are beautifully recounted by Savage:

In fancy's eye, encountering armies glare,
And sanguine ensigns wave unfurl'd in air:
Hence the deep vulgar deem impending fate,
A monarch ruin'd, or unpeopled state.

Thus comets, dreadful visitants! arise
To them wild omens, science to the *wise!*
These mark the comet to the Sun incline,
While deep-red flames around its centre shine!
While its fierce rear a winding trail displays,
And lights all ether with the sweeping blaze!
Or, when compelled, it flies the torrid zone,
And shoots by worlds unnumber'd and unknown,
By worlds, whose people, all aghast with fear,
May view that minister of vengeance near!
Till now, the transient glow, remote and lost,
Decays and darkens 'mid involving frost!
Or when it, sun-ward, drinks rich beams again,
And burns imperious on th' ethereal plain!
The learn'd one, curious, eyes it from afar,
Sparkling through night, a new illustrious star!

From the beginning of the Christian era till now, there have appeared about five hundred comets. Before that time, we have accounts of about one hundred others. But, when it is considered that there may have been many that have not been seen, from being too near the Sun, from appearing in moon-

light, from being in the other hemisphere, or from being too small, or from not being recorded, the number is probably much greater. Miss Herschel has discovered several comets within the last thirty years, by means of the telescope.—See *Phil. Trans.*

OF THE FIXED STARS AND SYSTEMS OF SUNS.

To form clear ideas in astronomy, and especially to make observations on the planets with any precision or satisfaction, it is needful that we obtain a tolerably correct knowledge of the principal fixed stars. It is evident, that the better we are acquainted with the appearance and places of these stars, which always remain at the same distance from each other, the more

readily we shall know the planets, which are continually altering their situations, by journeying, in their respective years, round the Sun. It must be premised, that the fixed stars shine by their own native light, and are, probably, suns to other systems of planets, of which we are and must remain ignorant:

> ——————Ten thousand Suns appear,
> Of elder beam; which ask no leave to shine
> Of our terrestial star, nor borrow light
> From the proud regent of our scanty day.
> BARBAULD.

To obtain this information, then, we begin with learning how to distinguish the pole of the world, or that point of the heavens, round which all the rest appears to move, while itself remains fixed. There is a tolerably bright star situated very near this point, and it is, therefore, called the *polar star;* it never departs from its situation, with

regard to the other fixed stars, and at every hour of the day and night, and in every season of the year, is to be found in the same position.

The general appearance, therefore, of the starry heavens, is that of a vast concave sphere, turning slowly round this polar star.

This star is more or less elevated, according to the part of the earth from which it is viewed: thus, more northward, as in Lapland, it appears much higher, or nearer the point over our heads, than it does with us. If we travel southward, it will appear lower than with us: we see it more elevated than the inhabitants of the south of France and Spain; and these again see it higher than those of Barbary, and the countries south of them. By continually travelling southward, we should see the pole star depressed to

the horizon, and the other pole would appear opposite to it, in the southern part of the horizon, round which the stars in that part would revolve. If we were still to travel onward to the south, the north polar star would disappear, and the whole hemisphere would appear to turn round a single point in the south, as our northern hemisphere appears to turn round the pole star in the north.

The polar star may be discovered by observing the motions of the stars, as already described; but there is a readier method, by a little attention to that collection of stars which astronomers distinguish by the name of the *Great Bear*. It principally consists of seven very conspicuous stars: four of these make an irregular kind of square, and represent the body of the beast, and the other three the tail, which is curved, or convex on one side, and

concave on the other. If a straight line be imagined to pass through those two stars of the body, which are farthest from the tail, and towards that part of the heavens to which the curve of the tail is convex, it will, at some little distance, pass very near to the bright star which we have described to be the north polar star. Knowing the polar star, it will be easy to distinguish the *cardinal points*, viz. *the north*, *south*, *east*, and *west:* the *north* is the side to which we are turned when we look at the pole; the *south* is the opposite side, or that on which the Sun appears at noon; the *east* lies directly on the right hand, when we look towards the north, and is that side on which the Sun appears to rise; the *west* is directly opposite to this, on the left hand, and is that side on which the Sun seems to set.

The time at which the greatest

number of stars are visible to the naked eye, is on a winter's evening, when the air is clear, and our Moon is not present. But even then a good eye can scarcely distinguish more than one thousand at a time; for though, at such a time, they seem almost innumerable, the appearance arises only from our viewing them altogether, and in a confused manner. But if we consider them distinctly, and only a small portion of the heavens at a time; and if, after some attention to the situation of the larger stars contained in that part, we begin to count them, we shall find they may be enumerated with considerable ease.

To avoid confusion in description, and to be able to point out any particular star, without being obliged to give a name to each, astronomers divide them into several parcels, or

groups, and to each of these is assigned a figure ; these assemblages, or groups of stars, are called constellations. Thus, a number of stars, near the north pole, is called the *Bear*, because the stars which compose it, happen to be at such distances from each other that they fall within the figure of that beast: and so of the rest. And, in order that the memory may not be burdened, even with the small number of distinct names which would occur in one constellation, astronomers mark the stars of each group with a letter of the Greek alphabet, denoting those which are the most conspicuous by the first letter, the next by the second letter, and so on in succession. By this means, they can be spoken of with as much ease as if each had a separate name.

The arrangement of the stars into

constellations is of the highest antiquity, as we may easily imagine, when, in the Bible, we find Job speaking of the constellations Orion and the Pleiades.

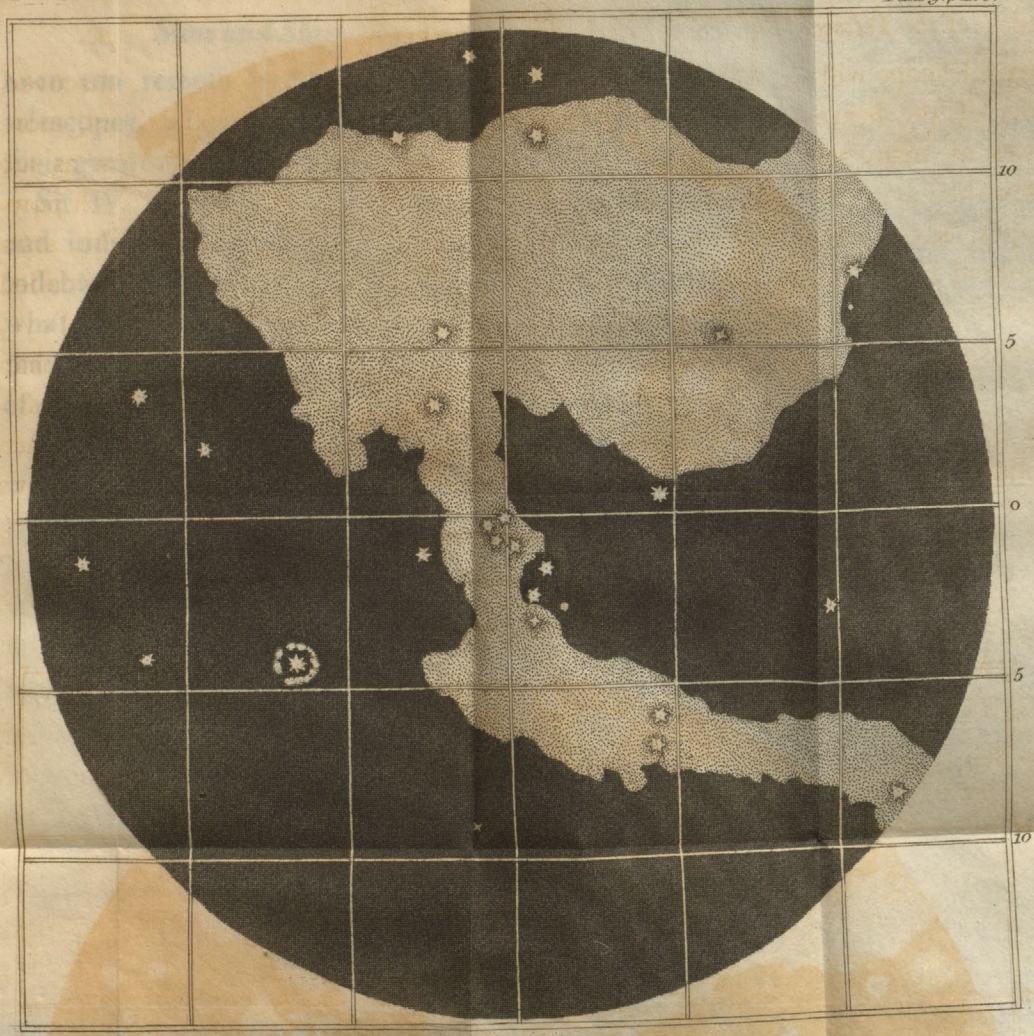
The fixed stars appear of different degrees of magnitude and brightness, and are, therefore, for farther distinction, divided into six different classes. Those, which seem the largest and brightest, are called stars of the *first magnitude;* and the smallest that we can see with the naked eye, are called stars of the sixth magnitude; the intermediate ones, according to their different apparent sizes, are called of the second, third, fourth, or fifth magnitudes. Those stars which cannot be seen without the assistance of the telescope, are not placed in any of these classes, but are called *Telescopic Stars.*

An ordinary telescope will discover, in many parts of the heavens, more than ten times as many stars as are visible to the naked eye. With powerful telescopes, seventy-eight stars have been counted in the group called the Pleiades, which, to the naked eye, appears to consist of not more than six or seven.* The astronomer Galileo reckoned eighty in a small space of the constellation Orion, and above five hundred more in another part, within a very small compass. In the whole of this constellation, above two thousand stars have been counted. Future improvements in telescopes may enable us to discover many stars that are now invisible to us; and there are, doubtless, many more which are

* See the plate representing this constellation, and the curious light space in the Sword of Orion, drawn as they appear in a good telescope.

THE LUMINOUS SPACE IN THE SWORD OF ORION.

Plate 9. p. 100.



NB. The 4 Stars in the Center, in an ordinary Telescope, appear as a Single Star but in one of a greater Magnifying power they are Seen Seperated.

3.rd Mag.de
4 Mag.de
5 Mag.de
6.th Mag.de
7 Mag.de

London: William Darton, 58. Holborn Hill; 7.th mo. 29.th 1823.

* See the plate representing this constellation, and the curious light space in the Sword of Orion, drawn as they appear in a good telescope.

even too remote to be seen through telescopes, when they have received their greatest improvement.

Sir W. Herschel, to whose science and industry astronomy is so much indebted, shewed, by his own labours, what great discoveries may yet be made by improving the instruments of observation.

The immense number of stars which were rendered visible with his large telescope, within a small space, make it reasonable to conclude, that in the whole heavens there are above eighty millions of stars! He also shewed, that many stars which, to the eye, or through ordinary telescopes, appear single, do, in fact, consist of two or more stars.

The luminous appearance of the milky way is shewn to be produced

by a multitude of small stars, placed so close to each other, as not to be entirely discernible even with the telescope. The nebulæ, or small cloudy specks, which are to be seen in different parts of the heavens, with a telescope, are also determined to be occasioned in the same way.

It is the general opinion, as it has already been observed, that each fixed star not only shines by its native and unborrowed light, but is a Sun to some other system of planets unknown to us, around which they revolve, as our Earth and its sister planets revolve about our Sun. For, it is not to be imagined that the Almighty, who ever acts with wisdom, and who creates nothing in vain, should have created so many glorious Suns, adapted to such important purposes, without pro-

per objects to be benefited by their influence:

——— Can those everlasting founts of light,
Bodies immensely vast! divinely bright!
Serve for no end at all? or, but to blaze
Through empty space, and useless spend their rays?
Consult with reason. Reason will reply—
Each lucid point, which glows in yonder sky,
Informs a system in the boundless space,
And fills with glory its appointed place:
With beams unborrow'd, brightens other skies,
And worlds, to thee unknown, with heat and life supplies. BAKER.

It is certain that they shine by their own light, for it is impossible that rays from our Sun should be sent to them, and then transmitted to us. How faintly does Saturn shine, notwithstanding his immense bulk! and yet his distance from the Sun is almost nothing compared with that of the nearest fixed star. Their distance is so great, that the best telescopes ex-

hibit them as mere points, instead of magnifying them, as they do any objects within a measurable distance. Mr. Huygens computed, that the distance of the nearest fixed star from us was so great, that a cannon-ball would spend nearly seven hundred thousand years in passing through this space, with the same velocity with which it first sets out. The same illustrious astronomer thinks there may be stars at such inconceivable distances from our Earth, that their light, though it is known to travel at the rate of about twelve millions of miles in a minute, has not reached us since the creation:

How distant some of the noctural Suns!
So distant, says the sage, 'twere not absurd
To doubt, if beams, set out at Nature's birth,
Are yet arriv'd at this our foreign world;
Yet nothing half so rapid as their flight.

YOUNG.

Every star, then, may be considered as the centre of some magnificent system, irradiated by its beams, and revolving about it by its influence. Thus the empire of God is magnified, his power, and wisdom, and goodness, made manifest. He is not glorified in one earth, or in one system of worlds, but in an indefinite number. Could we dart to the loftiest apparent star, we should there see other skies expanded; other suns distributing their inexhaustible beams of day; other stars decorating the hours of night; and other systems established in unknown profusion, through the boundless dimensions of space. And, as a good writer observes, "the dominion of the universal Sovereign does not terminate there: even at the end of this vast tour, we shall find ourselves

advanced no farther than the suburbs of creation, the frontiers of the great Jehovah's kingdom."

A WALK ON A STARRY NIGHT.

THE student in astronomy, who takes an evening's walk to admire the magnificence and the glory of the starry heavens, and who desires to profit by his observations, should learn to class the heavens into particular divisions, and fix on certain points, as a sort of land-marks to direct his attention.

By knowing the part of the heavens in which the Sun rises, he is able to determine the *eastern* side; by attending to its situation at *noon*, he ascertains the *south;* and by noticing the

place of its setting, he determines the western side of the horizon. He need not be told that the north is opposite to the south.

The moment, then, in which he casts his eyes on the sparkling expanse of heaven, he is supposed to be sensible of the bearings north, south, east, and west.

The next principle to be recognized is, that he sees above his horizon* one-half of the whole heavens; that is to say, one-half of the heavens are always visible, or above the horizon, and the other half is below the horizon. He must not expect, therefore, to see all the constellations and planets at once, but only that half which at the

* The horizon is the part all round, where the sky and the earth seem to meet.

time of observation is above the horizon.

For the sake of precision and accurate reference, astronomers have supposed the 360 degrees into which geographers divide the surface of the earth, to be extended to the heavens; so that the whole round of the horizon of the heavens is supposed to be 360 degrees, or proportional parts; half is 180 degrees, and a quarter is 90 degrees. And as we see one-half of the heavens above the horizon, it is of course 180 degrees from one side of the horizon, in a line passing *over our heads*, to the directly opposite side; and of course from the point over our heads, called the *zenith*, it is 90 degrees to the horizon on every side.

Remember, then, that the whole heavens are 360 degrees or proportional

parts round, and that it is always 90 of these degrees from the point directly over your head down to the horizon.

An observer of the heavens will discover the progression of the whole, from east to west, by a quarter of an hour's attention. Let him bring a star, in any part between the zenith and the southern part of the horizon, into apparent contact with the end of a house, steeple, or other fixed object, and he will in a few minutes perceive the motion of that star, and of the whole heavens, from east to west.

It may be proper for him at this time to consider, that this general motion of the whole heavens is merely apparent, and is occasioned by the rotation of the earth on its axis in a contrary direction. Of course, if the spectator is moving from west to east, the distant stars will appear to move

from east to west. The rising and setting of all the distant heavenly bodies will hence be easily understood. The earth turns completely round every twenty-four hours: every inhabitant of it will therefore be carried round towards all the bodies out of it, and distant from it, every twenty-four hours. Hence the rising and setting of the Sun, the succession of day and night, and all the dependent phenomena.

This progression of the whole heavens from east to west, the rising of some stars in the east, and the setting of others in the west, are objects which, viewed in this manner, will leave impressions much stronger than the mimic representation of the same phenomena on the celestial globe. The immensity of the great vault of heaven; the still, solemn, uniform

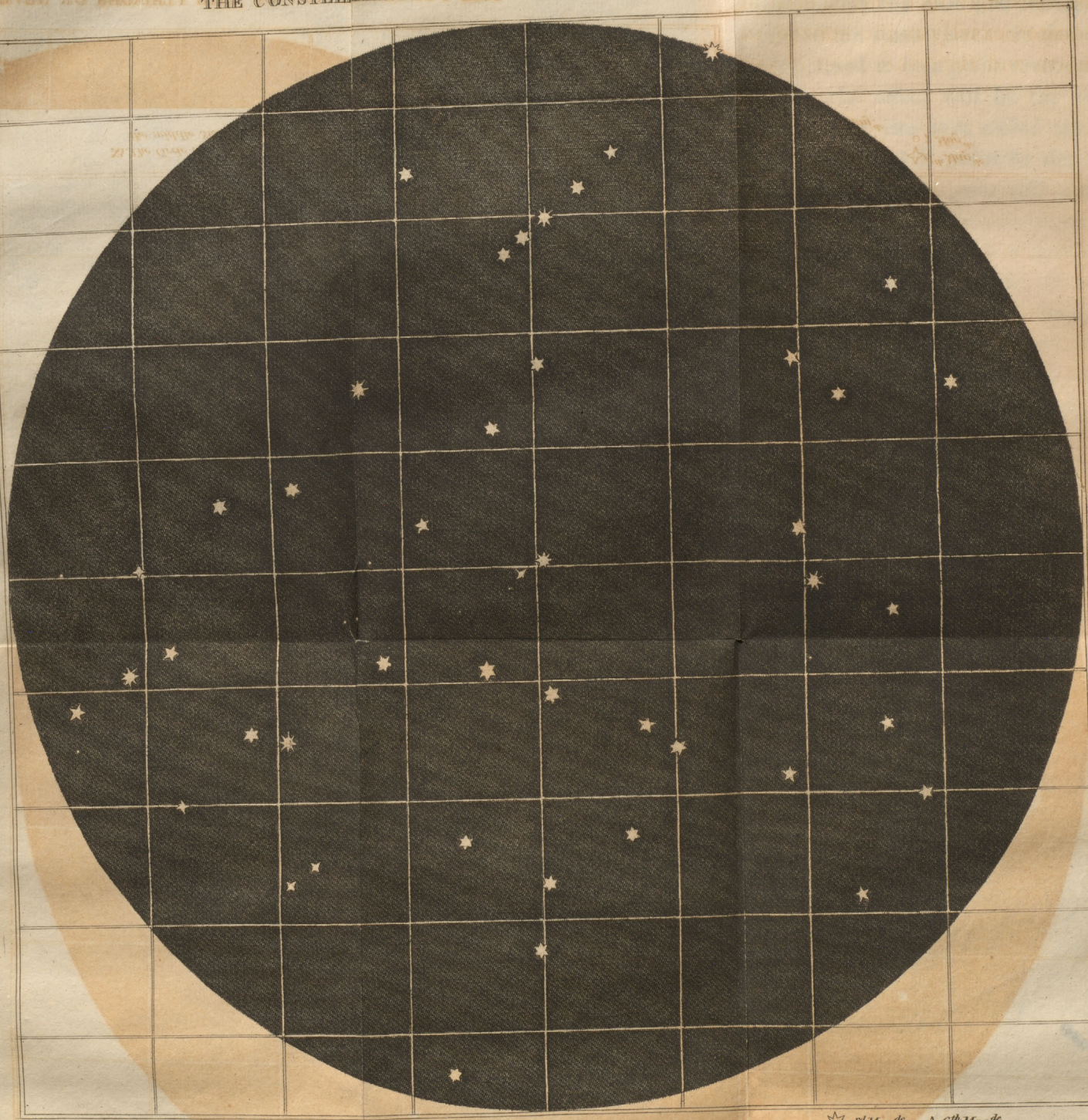
motion; the accompanying association of the immeasurable distances, the apparent perpetuity, and the countless numbers of the stars, will fill the mind with reverence and devotion towards the omnipotent, infinite, and eternal Author of the whole!

Having thus obtained ocular demonstration of the motion of the stars from east to west, or rather of the motion of the earth in the contrary direction, it will then be necessary to attend to a circumstance which is a consequence of that motion. A slight consideration will prove, that the stars immediately above the axis on which the earth may be supposed to turn, will appear to remain stationary over those places, at both ends of the axis. In turning a wheel on a fixed axis, all the parts of the circumference will successively present themselves to different

objects, but the axis will continue to point to the same place. If the wheel be supposed to be a globe revolving on an axis, the effect will be the same; the point of the axis, called the pole of the globe, will point to the same spot, while all the parts will perform smaller or larger circuits, in proportion as they are removed in a greater or less degree from the poles. It is important then to be able to determine the points in the heavens which are opposite to the poles of the earth; these always appear to stand still, while the other stars appear to make a daily circuit round them. As, however, we can only see 90 degrees from the point over our own heads, the inhabitants of no part of the earth can see both poles, except those who live at the equator, from which both poles are distant 90 degrees. The poles of

Rather above midway, between the

THE CONSTELLATION OF THE PLEIADES OR SEVEN STARS.



N.B. The Circle represents the Field of a Telescope of nearly 2 Degrees diameter The Stars are reversed and the middle Star Alcion would imploy 4 minutes to pass from the Center to the extremity of the Field.

3.rd Mag.de
4 Mag.de
5 Mag.de
6.th Mag.de
7 Mag.de

London: William Darton; 58 Holborn Hill; 7.th mo. 29.th 1823.

the heavens may therefore be seen at the equator, exactly in the horizon, in the north and the south; but if you travel or sail one degree to the north of the equator, so as to be within 89 degrees of the north pole, you will of course see one degree beyond the north pole, and not so far as the south pole by one degree; because, as before stated, you can always see 90 degrees in the heavens, from your zenith, or place over your head. In England, therefore, which lies between 50 and 60 degrees from the equator, or within 40 or 50 degrees of the north pole, we always see 50 or 60 degrees beyond the north pole; or in other words, the north pole in the heavens, or the stars immediately above the north pole of the earth, will be 50 or 60 degrees high.

Rather above midway, between the

horizon and the zenith, in the northern part of the heavens, we are to look for the north pole of the heavens, or the part which never appears to move. It happens that there is a star so near the north pole, that for all ordinary purposes it may be taken for the north pole itself, and this star may always be found very easily by means of two other stars which point to it in a right line. During the winter months these stars, which are in the constellation of the Great Bear, are to be found with the other stars of that remarkable constellation on the eastern side of the pole. They are about six degrees asunder, and the nearest is five times that space, or thirty degrees from the polar star, at which they seem to point, and are thence called the *Pointers*.

The north pole star being thus found, it will be a pleasing employment to

observe that all the stars appear to move round it, according to their several distances, while it constantly stands still. An hour's contemplation of this star, and of the motions of the rest of the heavens while it remains an immoveable centre, will teach more to the uninformed in astronomy than a thousand lessons or lectures in the closet.

On a winter's evening, the other remarkable objects in view will be the *Pleiades*, or *seven stars*, in the south-east; and below them, a little to the east, the grand constellation of *Orion;* and still lower, the dog-star *Syrius*, the brightest of all the fixed stars. The three bright stars together in a line, called the Belt of Orion, are at about equal distances from the Pleiades and Syrius, that is, about twenty-five degrees from each. Besides remembering this distance, and that of the *Pointers*

before-mentioned, for the sake of occasional comparisons, it will be useful to recollect that the most northern of the three stars in the belt of Orion is exactly over the equator, so that from that star to the north pole star is exactly ninety degrees.

The *Pleiades* are in the Zodiac, on the south side, and so is the red star, *Aldebaran*, near them; and the two bright stars about 40 degrees to the left, called *Castor* and *Pollux*, or the Twins, are also in the Zodiac, and about five degrees north of the Sun's place on the 12th of July.

On such an evening the milky-way will be seen in the west, as a light cloud, but in truth a mass or shoal of stars, almost infinite in number, but indistinct from their distance.

A celestial globe, rectified to the day and hour, will point to other ob-

jects ; an ephemeris will indicate the names or places of the planets which may be above the horizon ; and a telescope will render visible other interesting and wonderful phenomena.

Should the Moon be visible, the motion in her orbit may be rightly traced by her approximating to, or receding from, certain stars ; and the same may be observed in the motion of the planets in their orbits.

One, two, or three evenings, spent in making and in repeating these and similar observations, will bring into familiar use all the other facts and principles detailed in the several chapters of this Work ; and if a celestial globe should not be at hand, our projection of the heavens will be found a tolerable substitute for that useful and elegant machine.

OF THE CONSTELLATIONS,

OR IMAGINARY DIVISIONS OF THE STARS.

THE general splendour of a bright star-light night elevates the mind of the observer, while the seeming irregularity confounds it. In order to bring this vast collection into arrangement, it will be found needful to fix on some of the most distinguishable groups, and to make use of those as marks to conduct him among the rest, and to each group to assign the name given to it by the ancients.

The reader is supposed to be already sufficiently acquainted with the *Great Bear*, to be able to find it in the heavens without difficulty; and as this is the first constellation he is familiar with, and it is always visible to us, and al-

ways seen in the same quarter of the heavens, it is evidently the most proper with which to begin his operation of arrangement.

Let him, then, place himself in an open situation, on a clear evening of the month of January.

If now a straight line may be imagined to extend from the middle of the *Great Bear* through the polar star to an equal distance on the opposite side, it will pass through a group of eight or ten tolerably bright stars, which form a figure something like the letter W. This is the constellation called *Cassiopeia*: it has no stars either of the first or second magnitude, five of the third magnitude, six of the fourth, twelve of the fifth, and thirty of the sixth.

A constellation, called the *Little Bear*, may be known from its being nearly of the same figure as the *Great*

Bear; it is parallel to it, but in an inverted position; the *polar star* forms the tip of the tail. It has no stars of the first magnitude, one of the second, (the *pole star,*) two of the third, three of the fourth, five of the fifth, and two of the sixth.

If a line be imagined to pass through the two last stars in the tail of the *Great Bear,* and continued beyond the tail, about twice its length, it will pass through the constellation *Bootes,* and very near a very bright and very beautiful star of the first magnitude called *Arcturus.* This is a very brilliant group of stars: it contains one of the first magnitude, seven of the third, fourteen of the fourth, sixteen of the fifth, and thirty of the sixth: it has none of the second magnitude.

Turning towards the south, we observe the splendid constellation of

Orion; it is composed of nine or ten very bright stars, four of which form an irregular square: within these are three others, placed near each other; and in a straight line below them are three others of inferior lustre, which seem, as it were, to hang from them. The two higher stars in this square form the arms or shoulders of the figure; the two lower, his legs or feet; the three bright stars in the middle represent his girdle; and the three smaller, which are below them, his sword. The constellation *Orion* is by far the most brilliant and beautiful of any in our hemisphere, both with respect to the number of bright stars and the beauty of their arrangement. It contains two stars of the first magnitude, four of the second, three of the third, sixteen of the fourth, nineteen

of the fifth, and above thirty of the sixth.

If a straight line be drawn through the three stars which form Orion's belt, and continued on each side of that constellation, it will lead on one side to the star *Sirius*, or the Dog Star, and on the other to the Pleiades.

Sirius is a remarkably bright star of the first magnitude, and is nearer to us than any other of the fixed stars ; it is easily distinguished from the rest by its superior lustre.

The Pleiades, or what are commonly called the seven stars, are on the north-west side of Orion. It is recorded that there were formerly seven of these stars ; to the naked eye, however, they are now but six: they form part of a constellation called the *Bull.*

A very large star, which lies about

half way between the Pleiades and the western shoulder of Orion forms the Bull's eye ; it is a star of the first magnitude, and is called *Aldebaran.* The constellation of the Bull contains this star of the first magnitude, one of the second, four of the third, ten of the fourth, twenty of the fifth, and forty-six of the sixth.

A large bright star, which forms a triangle of equal sides with Sirius and Orion's belt, is also a star of the first magnitude, and is called *Procyon*, or *the Lesser Dog;* it lies to the north of Sirius, and to the east of Orion.

If a straight line be imagined to extend from the star *Procyon*, towards the north, the first bright star it meets with is *Castor*, a star of the first magnitude, and belonging to the constellation of *the Twins;* near this, to the south-east, is another bright star of the

same constellation ; it is of the second magnitude, and is called *Pollux.* Four stars, which lie at equal distances in a straight line, and about half way between the eastern shoulder of Orion and the Twins, form the four feet of the Twins. This constellation contains one star of the first, one of the second, four of the third, ten of the fourth, twenty of the fifth, and forty-five of the sixth.

A line drawn from the western foot of Orion, through the star Procyon, will lead to a very bright star of the first magnitude, in the constellation of *the Lion ;* it is called *Regulus.* If a line be drawn from a star in the middle of the Twins, through the star Regulus, it will, at a very little distance from it, pass below a square of bright stars, which form the rest of the constellation. The first bright star lying in a line,

almost east from Regulus, forms the tail of the Lion: the star is also of the first magnitude, and is called *Deneb*. The constellation contains two stars of the first magnitude, two of the second, six of the third, thirteen of the fourth, fourteen of the fifth, and forty-four of the sixth.

A line drawn from the star Rigel in Orion, through the star which forms his western shoulder, will, at about the length of Orion from him pass near a very bright and beautiful star in the constellation *Auriga:* the star is of the first magnitude, and is called *Capella*, or the Goat. This constellation has Capella, of the first, one of the second, nine of the fourth, twenty-one of the fifth, and twenty-four of the sixth magnitude.

The Crab is a constellation composed of small stars, difficult to distinguish;

a line drawn from the star Procyon to the tail of the Great Bear will pass through it. This constellation has no star either of the first, second, or third magnitude; it has seven of the fourth, eight of the fifth, and forty-three of the sixth.

A line drawn from the star Procyon, by Aldebaran to the westward, leads to the constellation of *the Ram*. This is called by astronomers the first constellation in the heavens, in point of order, because the group of stars which form its head lies nearest to that point where the Sun equally divides the year, making the nights equal to the days. The first star in the Ram's horn, which is the star astronomers reckon from, lies considerably more to the west than Aldebaran. This constellation has no star of the first magnitude, one of the second, one of the third, four of

the fourth, six of the fifth, and thirty-two of the sixth.

Now, draw a line from the Pleiades, in a direction north west, and the first bright star it meets is the first star in the constellation Perseus: the star to the north-west of this is his right shoulder, the star to the west is the left; and the brilliant star nearly south of the first star, is a star of the second magnitude, and this is the first of a group of stars in this constellation, called *Medusa's Head:* next to this, there are three others very near, which form the whole head; they lie something in the form of a square. The constellation has no star of the first magnitude, two of the second, four of the third, twelve of the fourth, thirteen of the fifth, and twenty-seven of the sixth.

A line drawn from the star *Castor*, through the pole star, and continued to

about the same distance on the other side, will meet the constellation of the *Swan;* its principal stars are disposed nearly in the form of a large cross. It has one star of the first magnitude, which is called *Arided*, six of the third, eleven of the fourth, fourteen of the fifth, and forty-nine of the sixth; it has no star of the second.

If a line be imagined to extend from the northern side of the square of the Great Bear, through the pole star, it will pass through the middle of the constellation *Pegasus*. Its three principal stars, which are of the second magnitude, form an equal square, with a bright star of the same magnitude in the head of its neighbouring constellation *Andromeda:* this last forms the northern corner of the square. A line drawn from the Pleiades, through the principal star of the Ram, will fall

upon the star *Algenib :* this is the southern corner of the square. The stars which mark the other two corners are called *Markab* and *Scheat*, of which Scheat lies to the north, and Markab to the south. This constellation has no star of the first magnitude, three of the second, three of the third, nine of the fourth, thirteen of the fifth, and fifty-one of the sixth.

The constellation *Cepheus* is contained between the Lesser Bear, Cassiopeia, and the Swan. A line drawn from the pole star to the star *Arided* in the Swan, will pass through the two principal stars in this constellation. It has no stars either of the first or second magnitude, three of the third, six of the fourth, twelve of the fifth, and thirty of the sixth.

These are the constellations which are the most conspicuous during the

winter months: those which shew themselves during the nights of summer, are not quite so important, or so distinctly marked; but after practising the method of finding the former with a little attention, these will also by the help of a globe, become easily distinguishable.

When the star in the middle of the tail of the Great Bear is on the meridian, and above the pole star, which takes place about nine o'clock in the evening towards the end of May, a very bright star may be observed towards the south, and in the meridian: this is the principal star in the constellation of the *Virgin;* it is of the first magnitude, and is called *Spica*, or the *Ear of Corn:* it will also be found to form a triangle of equal sides with the star Arcturus, and Deneb in the Lion's tail. The *Virgin* has one star of the

first magnitude, six of the third, nine of the fourth, sixteen of the fifth, and seventy of the sixth ; it has none of the second.

A little more to the right, but lower than the star Spica, a kind of square may be observed formed by four principal stars: this constellation is called *the Crow*. It has no stars either of the first or second magnitude, three of the third, two of the fourth, one of the fifth, and three of the sixth.

A line drawn through the two most eastern stars of the square of the Great Bear and the star Regulus, and continued a little farther south, will pass through a bright star of the second magnitude, called the *Heart of Hydra*. It is the principal star in the constellation *Hydra*, which extends from the Lesser Dog, under the Crow, to the lower part of the Ear of Corn. It has

no star of the first magnitude, one of the second, two of the third, twelve of the fourth, thirty-seven of the fifth, and forty-three of the sixth.

The constellation *Lyra* is marked by a very brilliant star of the first magnitude; it lies in the north-east quarter of the heavens, and forms a right-angled triangle with Arcturus and the pole star. This constellation has one star of the first magnitude, two of the third, three of the fourth, five of the fifth, and eleven of the sixth.

The *Northern Crown* is a small constellation, situated near to the star Arcturus, on a line drawn from that star to the Lyre; it is easily known, by its being composed of seven or eight pretty visible stars, disposed in a semicircle, or rather semi-oval, and one of which is of the second magnitude. This constellation is also pointed out,

by a line carried from the two first stars in the tail of the Great Bear. It has no star either of the first or third magnitude, one of the second, sixteen of the fourth, ten of the fifth, and fifteen of the sixth.

A very bright star which lies a little way south of Lyra and the Swan, is the principal star of the *Eagle*. It is easily known, by observing that it lies in a straight line, between two bright stars of the third magnitude, and very near them. The small groups of stars, that lie to the south of, and next to the Eagle, is called *Antinöus*. This has one star of the first, ten of the third, six of the fourth, fourteen of the fifth, and thirty-seven of the sixth.

A line drawn through the stars Regulus and Spica, will lead in a direction east-south-east to *Antares*, a star of the

first magnitude, and the principal star in the *Scorpion.* This constellation is very remarkable; for, to the south of Antares, there is an arch of stars, with its convex side towards the south; this forms the tail of the Scorpion, and seems as if it were a centre to the circle of stars round it. The Scorpion has one star of the first magnitude *(Antares)*, one of the second, ten of the third, seven of the fourth, nine of the fifth, and thirty of the sixth.

A bright star, which lies about half way between Spica and Antares, is the southern scale of the constellation called the *Balance:* the next bright star to this, in a north-east direction from it, is the northern scale of that small constellation; they are both of the second magnitude. The Balance has no star of the first, two of the

second, three of the third, ten of the fourth, four of the fifth, and twenty-three of the sixth.

The constellation *Sagittarius* follows the Scorpion to the eastward; a line drawn through the Swan and the Eagle will lead directly to it. It has no stars of the first or second magnitude, five of the third, ten of the fourth, twelve of the fifth, and sixty-four of the sixth.

A line drawn from Antares to the polar star, will first pass through the constellation Ophiucus, or *Serpentarius*, and a little higher through that of *Hercules*. A line from Antares to Lyra passes betwixt the heads of Hercules and Ophiucus; they lie very near to each other, and are stars of the second magnitude. The most eastern and southern of the two is the head of Ophiucus. The stars which lie to the north of the head of

Hercules, form the rest of that constellation; and those which are to the south of the head of *Ophiucus*, constitute that constellation.

Hercules has no stars of the first or second, seven of the third, twenty-six of the fourth, the same number of the fifth, and forty of the sixth. Ophiucus has no star of the first, one of the second, seven of the third, nine of the fourth, fourteen of the fifth, and thirty-six of the sixth.

A line drawn through Lyra and the Eagle, towards the south-east, leads to two stars of the third magnitude, and pretty near each other, which form the head of the constellation *Capricorn;* another star of the same magnitude, at about the same distance from the head that Lyra is from the Eagle, and lower towards the south, forms the tail of Capricorn. It has no stars of the first

or second, three of the third, four of the fourth, six of the fifth, and thirty-four of the sixth.

A line drawn from Lyra through the tail of Capricorn, will point out a very bright star of the first magnitude, called *Fomalhaut;* it is in the mouth of the constellation called the *Southern Fish.*

The group of five stars, of which four are very near each other, and in a lozenge-shaped figure, and lie next to the Eagle, in a direction nearly north-east from it, forms the constellation of the *Dolphin.*

It has no stars of the first or second magnitude; the five principal stars just mentioned are of the third; it has none of the fourth, two of the fifth, and eleven of the sixth.

A line drawn from the Dolphin to the star Fomalhaut will pass directly below the square of bright stars in

Pegasus, and will then pass through the whole length of the constellation *Aquarius*. It has no stars of the first or second magnitude, four of the third, seven of the fourth, twenty-five of the fifth, and sixty-two of the sixth.

A line drawn through the star Capella and the Pleiades will, at about the same distance, pass a bright star of the second magnitude, which is the first in the head of the constellation *Cetus*, or the Whale; a line drawn from the star Aldebaran, in Taurus, through this star, will pass through the whole constellation. It has no star of the first magnitude, one of the second, ten of the third, eleven of the fourth, nine of the fifth, and sixty-three of the sixth.

A line drawn from the Whale's Head to the middle of the square of stars in Pegasus, will have passed through the


THE
Plate II. P. 139.
London:
WILLIAM DARTON,
58
Holborn Hill.
7th Month 29th 1823.

THE CONSTELLATIONS as seen from the NORTHERN HEMISPHERE of the EARTH.

Plate II. P. 139.

London: WILLIAM DARTON, 58 Holborn Hill.
7th Month 29th 1823.

Engraved for THE WONDERS of the TELESCOPE.

constellation *Pisces*, or the Fishes. It has no stars of the first or second, one of the third, five of the fourth, twenty-five of the fifth, and sixty-two of the sixth.

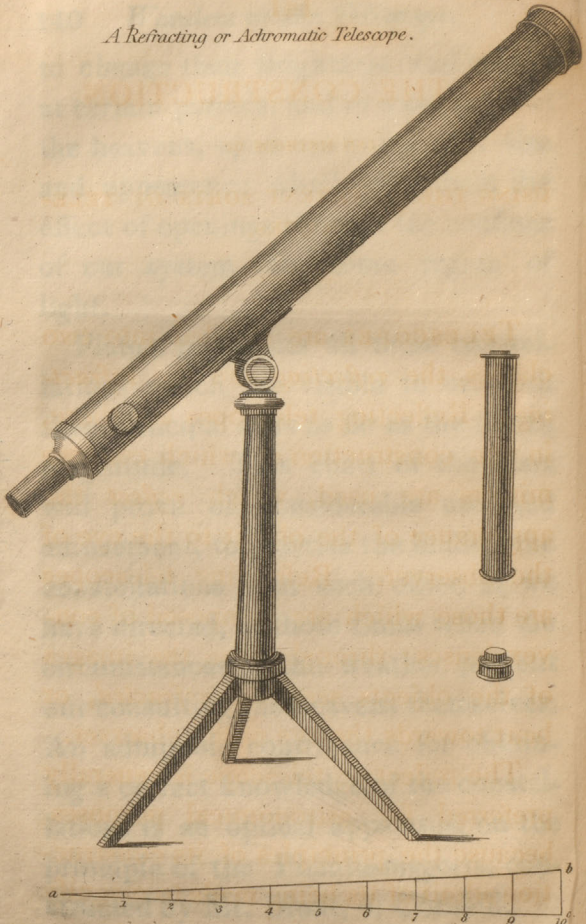
We have now mentioned all those constellations which are ever visible in this part of the Earth, except a few of such as for the present purpose are of less importance, as containing no remarkable stars.

The principal stars and constellations being known, it will be easy to trace the path, or to find any of the planets which may be at any time above our horizon. Besides this, the examination of the fixed stars with the telescope, will open a new source of amusement and instruction; many of those which appear single to the naked eye, are, with the telescope, discovered to be double. Many stars are found

to change their brightness and colour at certain periods, and in some parts of the heavens, spots are found of a size and appearance which give them the effect of openings through the confines of our system into some region of light.

Plate 9 represents all those constellations which are visible to us, with their principal stars as far as the fourth magnitude. This chart of the stars will prove of considerable use and amusement, to practise the finding the constellations from each other, as we have directed, at those times when the circumstances of the weather prevent our consulting the heavens themselves. An admirable contrivance for obtaining a correct knowledge of the constellations is an optical apparatus, on the principle of the Phantasmagoria, constructed by Mr. Blunt, of Cornhill.

A Refracting or Achromatic Telescope.



OF THE CONSTRUCTION

AND METHODS OF

USING THE DIFFERENT SORTS OF TELESCOPES.

TELESCOPES are divided into two classes, the *reflecting* and the *refracting*. Reflecting telescopes are those, in the construction of which concave mirrors are used, which *reflect* the appearance of the object to the eye of the observer. Refracting telescopes are those which are composed of convex lenses: through these the images of the objects seen are *refracted*, or bent towards the eye of the observer.

The reflecting telescope is generally preferred for astronomical purposes, because the principles of its construction admit of its being made to magnify

more than a refracting telescope of the same length.

The refracting telescope is preferred for the common uses of the instrument, because it is of a more simple construction, and therefore less liable to accident or derangement; it is, for this reason, constantly used by seamen.

The *night telescope* is a refracting telescope, constructed in the common way, but of a small magnifying power, and large or wide glasses; it is used principally by seamen. It must not be supposed that this instrument actually enables us to see in the dark. The effect of all telescopes is, that we are enabled to see a distant object with them as large and distinctly as if we were much nearer to it; and this is in proportion to what is called the magnifying power of the telescope; so that if an object be at a distance of eighteen

A Reflecting Telescope.

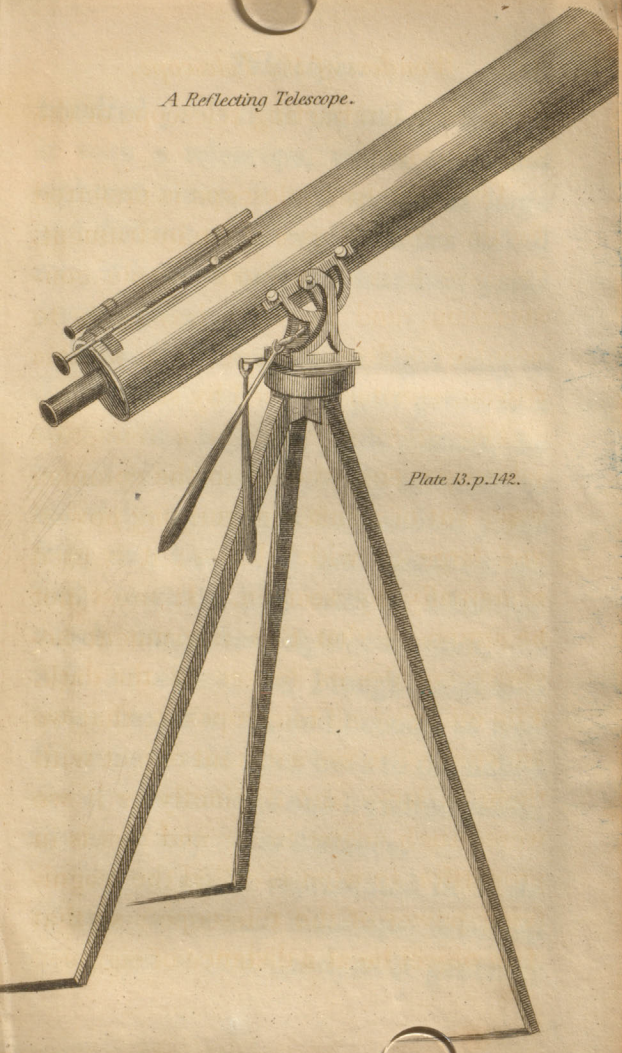


Plate 13. p. 142.

hundred yards from us, and we look at it with a telescope, which magnifies eighteen times, it will appear as large and distinct as it would to the naked eye, if it were only *one* hundred yards distant from us.

Now, if we suppose a night only so dark as that we could just perceive a man at one hundred yards distant, he would of course be totally invisible to us, if he were eighteen hundred yards from us; but if, at that distance, we look towards him with a telescope which magnifies eighteen times, he will, in effect, be brought eighteen times nearer to us, and become as visible as he would have been to the naked eye at a distance of one hundred yards; and so of any other distance.

The telescope represented in Plate 10 is a refracting telescope, mounted on a brass tripod stand, as it generally

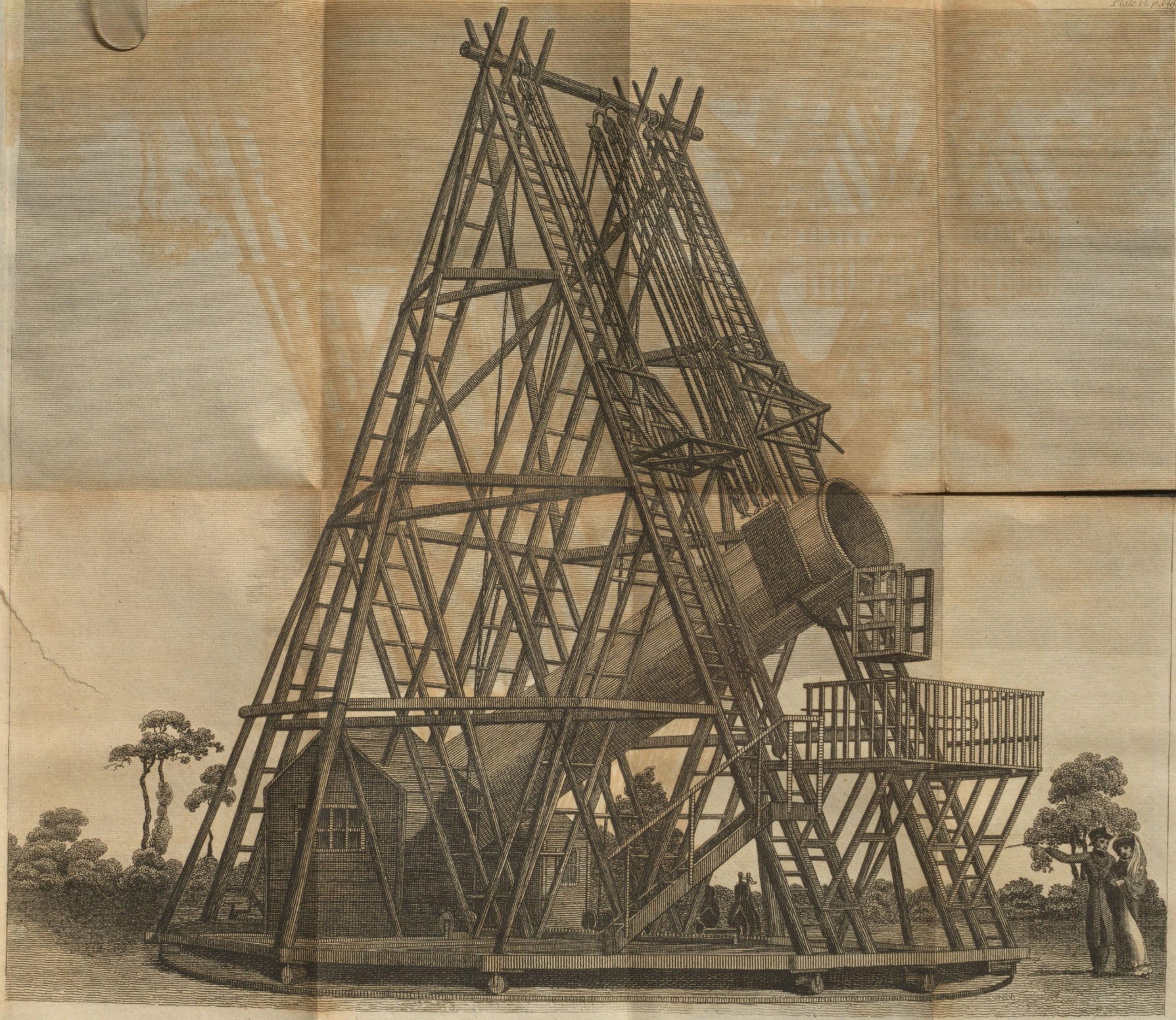
is for astronomical uses, and provided with two tubes of eye glasses, to change occasionally when it is wished to alter the magnifying power; when in use, they are screwed into a short tube at the smaller end of the telescope; when the shorter of the two sets of eye-glasses is used, the telescope magnifies the most. To use this instrument, there is nothing more to be done than to set it on its legs, as in the figure, and having uncovered the object-glass, (that at the larger end,) screw in one of the sets of eye-glasses, and, looking through the telescope, turn the brass button at the side of it, until the object you look at is seen distinctly.

Plate 11 represents a reflecting telescope, mounted as it generally is for astronomical purposes. This telescope is also provided with more than one

set of eye glasses, to change occasionally: they are screwed into the end of the large tube, as in the figure. The reflecting telescope has also the appendage of a small telescope, which is fixed to its side; it is of small magnifying power, and lies parallel to the tube of the large telescope; it is called the finder telescope, from its use being to point the large telescope to the object which is to be viewed. To understand the operation, it is necessary to know that the field of view of every telescope becomes smaller as the magnifying power is increased. Now, if the large reflecting telescope magnifies very considerably, its field of view will be small, and it will therefore be difficult to point it exactly to the object without many trials; but with a telescope of very small magnifying power,

and whose field of view is proportionably extensive, the object would be caught with much more facility. Such a telescope is therefore fixed to the large one, in such a manner, that it always moves with it, and points the same way. To set the large telescope correctly to any object, we avail ourselves of the above-mentioned property of the small one, and, bringing the object to the centre of its field of view, it will also be found at the centre of the other. Distinct vision is produced with this telescope by the screw, which is fixed to its side ; the turning of this, by its button, alters the distance of its mirrors from each other: it must be performed while the observer is looking through the telescope.

Plate 12 represents Dr. [Sir William] Herschel's great telescope.



VIEW OF HERSCHEL's FORTY FOOT REFLECTING TELESCOPE.

London: William Darton: 58 Holborn Hill; 7th mo 29th 1823.

OF THE MAGNIFYING POWER OF TELESCOPES.

MANY methods have been contrived to determine the magnifying power of any telescope by easy experiment. The late Mr. Ramsden, an eminent optician, invented a small instrument to measure the diameter of the pencil, or cone, which is formed by the rays of light passing through the telescope, and may be seen at the extremity of the eye-tube. If we divide the diameter of the large mirror in a reflecting telescope, or the diameter of the object-glass in a refractor, by the diameter of this cone of rays, as measured by the instrument, the quotient will express the magnifying power of the telescope: it is, however, expensive, and therefore not often used. A very

ingenious and simple apparatus has been contrived, to answer the purpose of this instrument, by Mr. Varley. It possesses the important advantage of being extremely easy of construction: indeed, any person, who can use a pair of drawing compasses with tolerable precision, may make it for themselves, and it is found sufficiently accurate for the common purposes of the experiment. His description of it is as follows:*—"Take a piece of thin writing-paper, rather more than two inches in length, and about half an inch in breadth, draw with a pen, or other proper instrument, the line *a*, *b*, in the lower figure of plate 12, and then, with a pair of compasses, set off one-tenth of an inch from *b* to *c*, with the same extent divide the line *a*, *b*, into twenty

* Philosophical Magazine, Vol. IV.

equal parts, making visible marks or punctures at each division: then draw the line *a*, *c*, and make the divisions, 1, 2, 3, 4, &c. to 10, at every other point made with the compasses, and put a small quantity of sweet-oil upon the paper to make it more transparent. These numbers are to express, in hundredths of an inch, the distance of the lines *a*, *b*, and *a*, *c*, at the points where they are placed. The divided paper being provided, adjust the telescope to distinct vision, by looking at some distant object, and then take off the brass cell which covers the end, or eye-glass: now direct the telescope to the open day-light, and take the divided paper in one hand, and a small magnifying-glass to view it with in the other; apply the proper scale to measure the diameter of the bright pencil,

or cone of light, as it proceeds from the eye-glass, and at that distance where it appears of the smallest diameter. This place, where the paper is to be applied, will be easily known, by observing, with the magnifying-glass, where the bright spot appears distinct and well defined at the edges, and, at the same time, the filament of the paper distinctly seen. By moving the paper slowly from side to side, or from the wide end of the scale towards the narrow, a part of it may be found, where the bright spot will just fill up the space between the lines *a*, *b*, and *a*, *c*. Suppose this to take place near the third division, when, of course, it will be three-hundredths of an inch in diameter; and suppose the diameter of the object-glass of your telescope to be two inches and one-tenth, or two

hundred and ten such divisions, these divided by three, the diameter of the spot will give seventy for the magnifying power.

" Again, suppose that, with another tube of eye-glasses, the cone of light fills the lines at the fourth division, divide the two hundred and ten by four, and it will give fifty-two—five, or fifty-two and a half, for the magnifying power."

Mr. V. also describes another method, which may be used in confirmation of the former, and is more simple, and well calculated to produce conviction.

" First, measure the space occupied by a number of the courses, or rows of bricks, in a modern building, which, upon an average, is found to have eight courses in two feet, so that each course,

or row, is three inches: then cut a piece of paper three inches in height, and of the length of a brick, which is about nine inches, so that it may represent a brick, and, fixing the paper against the brick wall, place the telescope to be examined at the distance of fifty or a hundred yards from it; now looking through the telescope at the paper with one eye, and at the same time with the other eye looking past the telescope, observe what extent of wall the magnified image of the paper appears to cover, then count the courses of bricks in that extent, and it will give the magnifying power of the telescope."

DESCRIPTION OF THE PLATES.

PLATE I. *to face the Title.—The Solar System* consists of the Sun, S. in the centre, round which the planets move in the following order: Mercury is nearest the Sun, and goes round it in the orbit *a;* Venus performs her revolution in the circle *b;* next to this comes the Earth at *c;* then Mars in the orbit *d;* Ceres follows in the path *e;* beyond her come Jupiter and Saturn in the orbits F and G. Besides these, the bodies *x* and *z* represent comets in their very eccentric orbits. Our Plate does not admit of a representation of the orbit of the Herschel planet, which is much beyond that of Saturn.

PLATE II. p. 24, *the Sun, as seen through a Telescope.*—We have here a good representation of the solar spots, which appear to be of very different magnitudes; some have been calculated to be five times greater than the whole surface of the Earth. The diameter of a spot is measured by comparing the time it takes in passing over a cross hair in the telescope, with the time in which the whole disk of the Sun passes over the same hair.

PLATE III. p. 43, *Venus, as seen through a Telescope.*—This is a representation of Venus when seen in her quadrature, or in a position similar to that of the Moon when she is about seven days old. The spots marked on the surface are such as have been seen on it by astronomers at different periods.

PLATE IV. p. 48, *the Moon, &c.*—This is an exact representation of the face of the Moon, as she is seen

through a telescope that magnifies between two and three hundred times. The dark parts are supposed to be water, as lakes, seas, &c., and the lighter parts, land; and, for the sake of distinguishing them, each of the parts has been marked by astronomers with a proper name. Thus No. 3, is called *Aristarchus;* No. 11, *Copernicus;* No. 18, *Archimedes. A* is called *Mare Humorum; B, Mare Nubium,* and so of the rest.

PLATE V. p. 64, *Mars, as seen through a Telescope.*—The dark parts on the surface of Mars exhibit the occasional changes of the partial belts which are sometimes visible on this planet. The variations noticed on the surface of this planet have been ascribed to clouds and vapours floating in its atmosphere.

PLATE VI. p. 67, *Jupiter and his Four Satellites, as seen through a Telescope.*—Besides the satellites which accompany this planet, and which move in orbits, that make a small angle with the planet's orbit, the surface of Jupiter is frequently surrounded with *belts* of various sizes, and in various positions. Their number is variable from one to eight. They are usually parallel to one another. The time of their continuance is very uncertain; sometimes they remain unchanged three months together, and, at others, only a few hours.

PLATE VII. p. 76, *Saturn and his Seven Satellites, as seen through a Telescope.*—This is a beautiful representation of Saturn, with his ring. The distance of the ring from the body of the planet is about equal to the breadth of the ring itself. There are also two belts on the surface of this planet parallel to one another, and to the ring.

PLATE VIII. p. 87, *the Comet of* 1680.—This Comet appeared, through a telescope, like a coal dimly glowing,

or a rude mass of matter illuminated with a dusky light. The plate represents the tail as it appeared when it was nearest the Sun. The tail increased in length and brilliancy as it approached the Sun, and grew shorter and fainter as it went farther from him and from the Earth.

PLATE IX. p. 100, *the bright Space in the Sword of Orion.*

PLATE X. p. 115, *the Constellation of the Pleiades, or Seven Stars, as seen through a Telescope.*

PLATE XI. p. 139, *Constellations, &c.*—This is a chart *in plano* of the principal stars visible in our hemisphere, and they may be easily known by attending to the following directions:

A line drawn from the centre of the plate (ε of Ursa Minor, the third from the pole star) through the plate towards the edges, and through the capital letter on its border, will respectively pass through all the stars of the first magnitude. Thus a line from centre of plate drawn to A, passes through *Fomalhaut*, the principal star in the southern fish; through B, Aldebaran, the principal of the Pleiades in the constellation of the Bull.

Through C. ——— Rigel, in Orion.
——— D. ——— Capella, in the constellation Auriga.
——— E. ——— Betelguer, in Orion.
——— F. ——— Sirius, in the Great Dog.
——— G. ——— Castor, in Gemini.
——— H. ——— Procyon, in the Lesser Dog.
——— I. ——— Regulus, in Leo.
——— K. ——— Dubhe, the Upper Pointer, in the Great Bear.
——— L. ——— Deneb in Leo.
——— M. ——— Spica Virginis, in Virgo.

Through N. ——— Arcturus, in Boötes.
——— O. ——— Antares in Scorpio.
——— P. ——— Lyra, in the Lyre.
——— R. ——— Arided, in the Swan.

PLATES XII. and XIII. p. 141 and p. 142, exhibit the figures of telescopes properly mounted, for viewing the heavenly bodies. Long handles seen under the *reflecting* telescope, are attached to certain screws, by turning of which the instrument is pointed to the object.

PLATE XIV. p. 146, *Herschel's Reflecting Telescope.*— This instrument, the largest ever constructed, is a curious specimen of a stupendous machine, rather than of an useful one. We believe it has been little used, it being found that the great mirror bent under its own weight, and consequently produced a distorted image. All the discoveries of Dr. [Sir W.] Herschel were made with a six-feet achromatic, but he constructed useful instruments of twenty and twenty-five feet in length, to which the same apparatus of motion was appended as is here represented.

G. SMALLFIELD, *Printer, Hackney.*

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